

Principal Accomplishments of the Colorado State University Research Team
from May 1, 1994 thru June 30, 1995 as Supported by NASA Ames
Cooperative Agreement #NAG-2-887

cc

FINAL
REPORT

Background:

In early March, 1994, I was named the Special Assistant for Education and Outreach to Dr. Joan Vernikos, the Chief of the Life and Biomedical Sciences and Applications Division (LBSAD), at NASA Headquarters. At that time, I was just ending a four-year IPA assignment at NASA Headquarters (ended on April 30, 1994).

Because of the emerging importance of science communications, education and other forms of public outreach to NASA, I assembled an experienced team of professional educators and information specialists at Colorado State University (Dr. Phillips and Ms. Billings) and proposed that the CSU team formally research this "new paradigm" in relationships that is rapidly emerging between government, industry, and the education community. Furthermore, in order to work closely with NASA managers, scientists and engineers, we proposed to structure this research as a three-year cooperative agreement, the first year activities and accomplishments of which are reported here.

Activities:

This cooperative agreement began on May 1, 1994, and one of the high points of the year occurred very soon after the inception of the cooperative agreement when, on May 19, NASA Administrator Dan Goldin presented me with the NASA Exceptional Service Medal for "...excellence in the management of NASA's scientific and educational programs."

This award was in recognition of the tremendous accomplishments made by NASA program and project teams (from 1988 through 1993) while I was the NASA Program Manager of the Search for Extraterrestrial Intelligence and the Space Life Science Training Program (SLSTP). While the award was given to me as an individual, it was actually for the exceptional commitment, professionalism, and technical expertise exhibited by our entire team of NASA Ames, KSC, JPL, Florida A & M and NASA Headquarters personnel.

As required by the cooperative agreement, the Colorado State University (CSU) team obtained first-hand information for our analysis of NASA Space Life Sciences education and public outreach programs and their relative effectiveness by working very closely with NASA and other government and non-government organizations.

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I attended LBSAD "tag-up" meetings at least weekly and had frequent meetings with Life Sciences Program Managers about how to develop or strengthen outreach activities within their programs.

Within NASA Headquarters, the CSU team members communicated on at least a weekly, sometimes daily, basis with Code U (the Office of Life and Microgravity Sciences) personnel and representatives of the other science offices, including Code S (the Office of Space Science), Code Y (the Office of Mission to Planet Earth), and the Headquarters Public Affairs Office (Code P) and the Division of Education (Code FE).

One of the first things the CSU team did was to recommend to Dr. Vernikos, the Chief of the Life and Biomedical Sciences and Applications Division (LBSAD) that she form an Education and Outreach Steering Committee (officially) made up of NASA civil service representatives from each of the NASA field centers with Life Sciences programs and (unofficially) of contractors and grantees who are involved in designing, developing, and implementing Life Sciences education and outreach activities.

The Steering Committee was formed and immediately began to construct a Space Life Sciences Education Outreach Plan in close coordination with the NASA HQ Division of Education. A draft of the plan is included as Appendix I. The CSU team functioned as the central coordinator for input to the plan. The plan is currently a final draft stage and is in the possession of the NASA Outreach Program Manager, Dr. Rose Grymes, at ARC.

In December, 1994 the CSU team coordinated a four-day "Space Life Sciences Week" display in the main foyer of NASA Headquarters for the purpose of highlighting to other members of the NASA Headquarters staff the important contributions LBSAD-funded programs make to space science, engineering, and the improvement of the quality of life on earth.

We used this display as a backdrop for the signing of an MOA between NASA and the Loma Linda Medical School that allows the use of the LLU Proton Beam Facility to help investigate the effects of proton radiation on living cells and tissues (Appendix II). The CSU team assisted NASA managers in setting up the logistics for the signing ceremony and the follow-on luncheon with the NASA Administrator.

At the three NASA field centers with Life Sciences-funded programs (ARC, JSC, and KSC), we interacted on at least a monthly basis with the persons appointed at each field center as Space Life Sciences Outreach contact persons. At ARC, it was Mr. Syd Sun (now is Dr. Grymes), at JSC it was Dr. Gerry Taylor, and at KSC, it was (and is) Mr. Dennis Chamberland. Several times during the year, one of more of us traveled to each field center and reviewed the goals,

At my suggestion, Dr. Vernikos awarded the First Annual SpaceLife Sciences "Return on Investment" Award to Mr. Richard Sauer, a Life Sciences engineer who had just received the NASA Invention of the Year Award for his revolutionary new idea in wastewater treatment (Biocide Delivery Unit).

In response to a request from the NASA Administrator's office for short, concise summaries of contributions to biomedicine from Space Life Sciences-supported science and engineering, the CSU team assembled over 20 informational "one pagers" (Appendix III), each of which focuses on a specific Space Life Sciences accomplishment in science or engineering which positively impacts "quality of life" issues for the American public.

The CSU team also assisted Space Life Sciences managers in the writing and editing of several key publications. Principal among these were: (1) the short summary of 1993 LBSAD activities and accomplishments in Space Life Sciences (Appendix IV-A), (2) a summary of the highlights of Space Life Sciences-supported research with applications in medicine and health care (appendix IV-B), and (3) the LBSAD publication entitled "Life Sciences Accomplishments '94". In this last publication, the CSU team contributed significantly to the chapter on "Outreach" (Appendix IV-C).

Often, our involvement with field center personnel was more involved than just a brief review of their programs. For instance, the CSU team helped JSC organize a two-day meeting for the outreach coordinators of each of the eight NASA Specialized Centers of Research and Training (NSCORT).

At this meeting CSU team members participated in discussions of the importance of outreach to NASA and the academic/science communities, helped compare and contrast outreach strategies between the various NSCORTs, and suggested methods of improving coordination and collaboration between each NSCORT.

We traveled to KSC to meet with the KSC Education Program Officer and participated in discussions between KSC and EPCOT Center personnel concerning how best to design and implement a Space Life Sciences-focused event associated with EPCOT's annual "Space Week".

As a previous Program Manager of the KSC-Florida A&M University Space Life Sciences Training Program (SLSTP), I was honored to deliver congratulatory remarks from Dr. Vernikos at the SLSTP graduation banquet (July 30). In September, I participated in the Headquarters annual review of SLSTP.

I traveled frequently to the Ames Research Center to support the ongoing planning and implementation of the Ames STELLAR program and to help transition overall management of the NASA Space Life Sciences Outreach program to the new NASA Program Manager, Dr. Rose Grymes.

The CSU team performed a thorough review of the Colorado Space Education Initiative (CSEI), a teacher-focused program organized by the Aerospace States Association and sponsored by the LBSAD. We offered several suggestions for improvement and suggested ways in which the program could reinforce other Space Life Sciences activities.

During this period (prior to a NASA Program Manager being selected), I also acted as Dr. Vernikos' advisor in the area of Advanced Technology Development.

Most of the activity in this area during the May 1994 to January 1995 period focused on working closely with representatives of the Ames Research Center and the Environmental Protection Agency on the development of a HAZMAT response vehicle which utilized NASA-developed telerobotics to allow response team members to approach a toxic spill without endangering themselves.

CSU team members also attended various seminars and symposia wherein outreach-oriented information was reported and discussed. I have included (as Appendix V) a report submitted by Ms. Billings to NASA managers on the briefing that accompanied the release of a study entitled "The Information Needs of the Public Concerning Space Exploration" by Professor Jon Miller.

My major focus for most of the year was as the Code U representative (*ex officio*) to the NASA Science Communications Working Group, a group that was formed at the request of the NASA Chief Scientist to thoroughly review all NASA efforts in science communications and public relations and to make recommendations for improvements. The meetings of this group consumed the equivalent of three days per week from May, 1994 through June 15, 1995. I have included a draft final summary as Appendix VI.

Everyone on the CSU team is acutely aware of the need to attract more women and members of other historically underrepresented groups to careers in science and engineering. Thus, we devoted a considerable effort to establishing close working relationships with managers within the NASA Office of Equal Opportunity Programs. I was named the Code U point of contact for the NASA American Indian Science and Technology Education Consortium (AISTEC) and was pleased to be asked to give the concluding remarks at the African American Heritage Month Assembly in the NASA auditorium and attended meetings of the Headquarters Native American Advisory Committee.

Before it was disbanded in January, 1995, the Congressional Office of Technology Assessment (OTA) was working on a study entitled "Telecommunications in Native America: Challenges and Opportunities". I was asked by the OTA to contribute to the report and to be a final reviewer.

The final product is a report that serves as an effective roadmap to NASA and all government agencies with respect to how telecommunications technologies can be beneficially applied to a historically underserved population of Americans.

I arranged for the signing of an Unreimbursed Space Act Agreement between NASA LBSAD and (1) the Navajo Community College and (2) the Cherokee Nation of Oklahoma wherein NASA would provide these two organizations with Internet connectivity, training, and one-year of line fees. Teachers from the Shiprock, NM and Tahlequah, OK area were invited to participate in the Johnson Space Center's Summer Teacher Enhancement Program (STEP) where the teachers learned how to obtain and use Internet accessible information in the classroom.

I have included a copy of the Navajo Community College agreement as Appendix VII, along with a letter of appreciation from the President of the Navajo Nation and a news article from the December, 1994 Gallup, NM *Independent*.

Ms. Billings is particularly active in the area of gender equity in science education and is a senior member of the Women in Aerospace Organization. She was also appointed a member of the organizing committee of the Goddard Space Symposium, is a member of the American Astronautical Society's Committee on Education, and participated in the new NASA Task Force on careers for women in science and engineering.

Ms. Billings wrote and published a commentary on the importance of the space life sciences in Aerospace America and a feature article on LBSAD accomplishments in U.S. Medicine.

Besides supporting the other activities of the CSU team, Dr. Phillips was particularly active in speaking at civic groups in support of the potential benefits from science to be conducted on the International Space Station, lectured at the Space Life Sciences Training Program on Nutrition in Space, and was a central organizer and participant in the NASA Education Update for Teachers Interactive Video Teleconference.

While this list and the accompanying appendices are not intended to be comprehensive, they serve to give the reader a good cross-section of the important activities in which the CSU participated during May, 1994 thru June, 1995. The "lessons learned" from these and other education outreach activities have enabled the CSU team to better understand the critical activities that NASA and the LBSAD are undertaking to support this increasingly important partnership between government, academe, and private industry.

Appendix I

Draft (February, 1995) Space Life Sciences Education Outreach Plan which
was Compiled and Edited by the CSU Outreach Team

DR. G. R. COULTER

February 1995

Education Outreach Plan
for the
Life and Biomedical Sciences and Applications Division

Prepared by the Education Outreach Steering Committee:

Gerald Taylor/JSC, Chairman
Duncan Atchison/LESC
Linda Barrientos/ARC
Dennis Chamberland/KSC
Thomas Dreschel/KSC
Rose Grymes/ARC
Barbara Jo Navarro/ARC
Sidney Sun/ARC

Approved by: _____
Joan Vernikos, Ph.D., Director, Life and Biomedical Sciences and Applications
Division, Office of Life and Microgravity Sciences and Applications, NASA HQ

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Introduction

In 1994, the Director of the Life and Biomedical Sciences and Applications Division (Office of Life and Microgravity Sciences and Applications, NASA Headquarters) decided that education outreach should become an integral part of all of the Division's activities. Consequently, the Director appointed a Steering Committee, including representatives of NASA's three life sciences field centers, to develop an education outreach plan for the Division. In January 1995, after months of deliberation and consultation with NASA's Education Division, the Education Outreach Steering Committee completed a plan to improve the quality and effectiveness of its life sciences education outreach efforts.

This plan, to be put into effect immediately, is intended to support OLMSA's and NASA's strategic plans for education and our national education goals. As outlined in the plan, the primary means of fulfilling this intent are teacher enhancement, K-12 education initiatives, and targeting of underrepresented groups.

The plan articulates a number of objectives intended to encourage individual initiative and coordinated field center efforts and to show the NASA life sciences community how to make education outreach an integral part of its activities. These objectives are to:

- *Increase public awareness;*
- *Improve K-12 education;*
- *Improve undergraduate, graduate, and post-graduate education;*
- *Improve inter-center communication and coordination;*
- *Improve partnerships with educators;*
- *Target underrepresented groups; and*
- *Measure effectiveness of efforts.*

Executive Summary

By implementing an education outreach plan, the Life and Biomedical Sciences and Applications Division (hereafter referred to as the Division) intends to redefine education outreach for the life sciences community: education outreach is no longer an extracurricular or optional activity but an integral part of our mission, and all significant life sciences activities henceforth will have educational components.

For the purposes of this plan, education outreach is defined to encompass activities aimed at teaching science, math, and technology to students, educators, and the general public; advancing scientific and technical literacy; and informing the public of the benefits derived from Division activities. The Division's strength lies in its researchers and its space- and ground-based research facilities, resources that can be put to good use in furthering the goals of this education outreach plan.

Through this education outreach plan, the Division intends to increase the impact of its educational efforts by instituting a comprehensive program of review, evaluation, collaboration and shared implementation strategies across all space life sciences organizations. The plan:

- Describes NASA, OLMSA, and Division goals in education outreach;
- Identifies areas of education outreach requiring emphasis;
- Establishes an organizational and programmatic infrastructure to support education outreach; and
- Encourages everyone in the NASA life sciences community to participate in education outreach and explains how to do so.

The audience for the Division's education outreach activities is the public at large. However, students and educators are the primary targets. Traditionally, NASA has enjoyed good relationships with colleges and universities, supporting many post-secondary students and academic researchers. Today, education outreach to elementary and secondary schools requires increasing emphasis; by working with younger students and their teachers, NASA can instill greater interest in science, math, and technology.

This plan recognizes that women, underrepresented minorities and other targeted groups are still relatively scarce in the space life sciences. Thus, to improve diversity in the space life sciences, The Division's education and outreach efforts will focus especially on encouraging students in these groups to pursue life sciences careers.

Another important element of this plan is the need for leveraging of resources. In the face of flat or shrinking budgets, the Division must leverage its education outreach efforts across field centers and with other Federal agencies, in order to accomplish more for less. One way of accomplishing this goal is to work more closely with teachers and professors in elementary and secondary schools, colleges, and universities. One-on-one contacts between

NASA life scientists are invaluable, but by providing more support to educators, the Division can reach more students with greater effect.

This plan is intended to encourage participation in established NASA education outreach activities as well as those arising out of individual interest and initiative, without creating any additional bureaucracy that might discourage participation.

This plan identifies objectives along with strategies for implementing these objectives. To accomplish them all will require the collective efforts of all Division personnel. For this reason, achievements will be measured NASA-wide: ARC, JSC, KSC, and NASA Headquarters will be treated as a single organization as the Division measures progress against this plan.

Strategy for Change

Improving the U.S. education system is a national priority, established by Federal law. NASA, unique in its ability to inspire and excite the public about science and technology, has a vital role to play in meeting this national goal. NASA's Strategic Plan for Education. A Strategy for Change: 1993-1998, explains how the Agency will help promote excellence in education.

NASA's strategy for education clearly defines a vision, goals, enabling systems and management priorities. In line with this plan, the Office of Life and Microgravity Sciences and Applications developed an education plan that supports NASA and national education goals. In preparation for developing its own education plan, the Life and Biomedical Sciences and Applications Division directed ARC, JSC, and KSC to audit their existing education outreach activities (according to a method recommended by NASA's Education Division, so that results could be incorporated into an Agency-wide audit). Following this audit, the Division's Education Outreach Steering Committee developed a plan articulating education outreach objectives for the Division along with implementation strategies for each objective.

The Life and Biomedical Sciences and Applications Division's vision for improving education is the same vision articulated in NASA's Strategic Plan for Education: to promote excellence in America's education system by undertaking activities that enhance and expand the scientific and technological competence of all Americans. The overarching goal of the Division's education outreach plan is to use its unique missions, facilities, and work force to support the Office of Life and Microgravity Sciences and Applications education plan and NASA's Strategic Plan for Education, toward enhancing awareness, capturing interest, and increasing students', teachers', and the general public's knowledge of life sciences. As stated in NASA's Strategic Plan for Education, "NASA and the Nation's education system share the same goals -- exploration, discovery, the pursuit of new knowledge -- and achievement of these goals is interdependent. NASA depends on the U.S. education system to produce a skilled and knowledgeable work force. The education community, in turn, uses the space program to motivate and encourage students to study science, mathematics, engineering, and technology and to offer students and educators unique research experience in those fields."

The Division's management priorities for guiding change are to:

- Maintain the Life and Biomedical Sciences Education Outreach Steering Committee to oversee program review and coordination;
- Enhance communication about and coordination of Division education programs among field centers and Headquarters;
- Establish a Division strategy for education outreach based on the Division's education outreach plan; and
- Coordinate activities with the NASA Education Division.

Education Outreach Objectives

The Education Outreach Steering Committee has identified the following objectives to fulfill, along with implementation strategies:

Objective #1: *Increase public awareness and understanding of life sciences.*

As stated in NASA's Strategic Plan for Education, "to ensure our global competitiveness, the U.S. must have scientifically literate citizens capable of understanding complex, economic, political, ethical, and social issues derived from an increasingly technological society. Moreover, a scientifically literate public will understand the need for a robust research enterprise and will encourage and motivate our youth to study mathematics and sciences. Without this encouragement, science education efforts for the Federal government will be less effective. NASA is strengthening its program to increase public understanding of science in order to satisfy the emerging science literacy standards."

IMPLEMENTATION STRATEGIES:

- *Broaden dissemination of information on NASA-sponsored life sciences activities:* Research funded by the Division generates a wealth of scientific data of interest and benefit to a broad audience of people inside and outside the life sciences community. The Division will disseminate this information as widely as possible in a timely manner, in a form that is understandable to its intended audience, by means of public presentations, publications, news releases, and other information products and services, especially capitalizing on innovative communication technologies. Telecommunication methods such as computer networks and videoconferences are efficient means of distributing information and ideas. The Division will expand its use of such broadcast methods to disseminate information.
- *Encourage tours of life sciences facilities:* Inform NASA Public Affairs Offices at the field centers and Headquarters about life sciences facilities that are open to visitors. The Division will formulate a list of candidate facilities, noting any restrictions that apply. In addition, the Division will notify the PAO of special events in life sciences that may be of interest to visitors.
- *Managers and supervisors will encourage broader participation (by civil servants, contractors, and grantees) in education outreach:* Education Outreach Steering Committee members will contact public affairs and education program officers to encourage the use of life sciences personnel for NASA-sponsored and non-NASA-sponsored education outreach events. Consistent with mission objectives, supervisors will offer incentives to encourage employee participation.

Objective #2: *Use the excitement of ground- and space-based research to enhance K-12 education:* NASA's Strategic Plan for Education states that part of NASA's mission is to "enhance the content knowledge, skills, and experience of teachers, to capture the interest of students, and to channel that interest into related career paths through the demonstration of integrated applications of science, mathematics, technology and related subject matter." NASA's Life and Biomedical Sciences and Applications Program includes a wide variety of

unique and existing research that can spur students to learn more about science and technology. The Division's current focus is grades K-12, with an emphasis on the lower grades, teacher training and enhancement, and curriculum development, enabling the Division to reach more students.

IMPLEMENTATION STRATEGIES:

- *Help teachers develop curriculum enhancement materials:* Many research projects sponsored by the Division could spawn interesting activities for K-12 classes. The Division encourages the life sciences community to share plans and findings with K-12 teachers toward creating interesting, hands-on learning experiences for students. Several existing NASA programs -- including Science Training for Enhancing Leadership and Learning Through Accomplishments in Research (STELLAR) and the NASA Educational Workshops for Elementary School Teachers and for Math, Science, and Technology Teachers (NEWEST and NEWMAT) -- train K-12 teachers and assist them in developing new curriculum materials. The Division will contribute information and expertise to existing programs as appropriate.
- *Ensure that life science-dedicated flight missions incorporate educational components providing for real-time student involvement:* Flight missions focusing on life sciences research offer the opportunity for real-time, hands-on student participation. From now on, all life science-dedicated flight missions will include a hands-on-science curriculum unit that will be disseminated to teachers in advance of the flight, explaining how to conduct experiments similar to those that will be executed in space. Experience has shown that this kind of activity succeeds in using the natural excitement of space flight to motivate students to learn.
- *Assist in the professional development of teachers through in-service and pre-service hands-on training:* Life sciences principal investigators will invite teachers to work with them in their labs, providing opportunities for hands-on science and mentoring them as appropriate. In addition, Division education programs will include teacher training in Internet access and other computer skills, which will be necessities for teachers in the future. These skills will provide teachers and their students real-time communication with researchers all over the world, working in the lab and in the field. It is imperative that life sciences management encourage partnerships between teachers and researchers to enhance science education.
- *Encourage employee participation in education, as instructors, mentors, tutors, and committee members:* It may not be easy for members of the life sciences community to make time for education outreach activities in addition to their duties in the office or lab. But improving science education is of vital importance and deserves our contribution. Hence, managers should encourage staff to participate in education activities as part of their work.

Objective #3: *Use the excitement of life sciences research to enhance post-secondary education:* NASA has a multitude of post-secondary educational activities that help the Agency accomplish its mission objectives and academic institution accomplish their education and research objectives. The Division will continue to support and participate in these activities, and it will emphasize the funding of research which encourages hands-on learning by students or educators.

IMPLEMENTATION STRATEGIES:

- *Help post-secondary instructors develop curriculum enhancement materials:* The Division will encourage its researchers to invite post-secondary instructors and students to collaborate in developing curriculum enhancement materials.
- *Ensure that life science-dedicated flight missions have educational components providing for real-time student involvement:* For all life science-dedicated flights, the Division will establish a point of contact for education outreach who will work with the Division's Education Outreach Steering Committee, the project scientist, center education program officers, and local educators to develop a mission-specific education outreach program.

Objective #4: Improve communication and coordination among Division organizations to increase the effectiveness of their educational efforts.

IMPLEMENTATION STRATEGIES:

- *Maintain a Life Sciences Education Outreach Steering Committee including representatives of ARC, JSC, KSC, and Headquarters and meeting regularly, rotating among field centers and Headquarters.* The Steering Committee will serve the purposes of developing education outreach objectives and implementation strategies, reviewing and strengthening current education outreach activities, and coordinating activities with NASA's Education Division. In consultation with their center education program officers, field-center Steering Committee members will monitor ongoing activities at their centers to determine whether they are contributing to Division, program office, and Agency-wide education objectives.
- *Encourage the joint development and implementation of inter-center education outreach:* ARC, JSC, KSC, and Headquarters will closely coordinate life sciences education outreach efforts.

Objective #5: Strengthen partnerships between the NASA life sciences community and professional educators at all levels.

IMPLEMENTATION STRATEGIES:

- *Provide life sciences information and curriculum materials to agency-wide education outreach programs:* Life Sciences Education Outreach Steering Committee members will work with field-center and Headquarters colleagues to ensure the free flow of information on life sciences to the education community. Steering Committee members will be responsible for soliciting information from their colleagues and informing them about what types of informational materials are appropriate for educational use. Steering Committee members will be responsible for working with existing distribution networks such as NASA Teacher Resource Centers and NASA Spacelink to determine appropriate life sciences input. The Steering Committee also will determine how to compile and distribute useful life sciences curriculum materials. Curriculum materials should be prepared according to letters of agreement among NASA life sciences personnel, field-center management, and educators. In consultation with NASA's Education Division, the Steering

Committee also will determine how to evaluate and revise life sciences curriculum materials.

- *Demonstrate life sciences curriculum materials and activities in teacher training programs:* Steering Committee members should take advantage of the opportunities provided by ongoing NASA in-service teacher training programs to introduce, test, or improve curriculum materials. These training programs also provide excellent opportunities for informing educators of life sciences activities with potential educational value.
- *Participate in education conferences to disseminate information on life sciences research:* Education conferences provide an opportunity for life sciences personnel to participate in workshops, exhibits, and other activities that provide avenues for distributing information on life sciences. Educators especially appreciate the opportunity to talk with lab and field researchers.
- *Inform scientists and engineers about life sciences education outreach techniques, materials, and activities:* NASA personnel who participate education outreach activities are often rich in enthusiasm and information but poor in education and communication experience, and education outreach activities can suffer because of this gap. In consultation with NASA's Education Division, the Education Outreach Steering Committee will ensure that life sciences personnel who are interested in contributing to education outreach are prepared to meet student and teacher needs.
- *Establish an advisory panel of life science educators to guide the development and implementation of education outreach activities:* The Life Sciences Education Outreach Steering Committee will assemble an advisory panel of professional educators to help develop and implement education outreach activities. Successful accomplishment of this task will require the full support of field-center and Headquarters management.

Objective #5: *Develop and implement life sciences education outreach programs that encourage women, underrepresented minorities, and other targeted groups to pursue careers in science, mathematics, and technology.*

IMPLEMENTATION STRATEGIES:

- *Work closely with NASA's Office of Equal Opportunity Programs:* The Division will continue to work closely with the Office of Equal Opportunity Programs to support existing education initiatives for targeted groups, expand involvement, and develop new programs focusing on life sciences.
- *Participate in ongoing education outreach programs for targeted groups:* The life sciences community can, for example, provide mentors for NASA's Summer High School Apprenticeship Program (SHARP), targeting female and minority students; and contribute resources and expertise and other resources to programs such as the NASA Junior Fellowship Program and the Historically Black Colleges and Universities Program that encourage the professional development of underrepresented minorities.
- *Participate in activities that encourage students to pursue science, math, and technical careers:* Efforts to encourage local students to participate in NASA activities -- such as Take Our Daughters To Work Day and career days in schools -- should especially target underrepresented groups.

Objective #6: *Establish new and improve existing education outreach partnerships with other Federal agencies and public and private organizations:* NASA's Strategic Plan for Education calls for expanding the impact of NASA education programs by developing partnerships with external constituencies.

IMPLEMENTATION STRATEGIES:

- *Establish agreements with other Federal agencies and public and private organizations to develop collaborative projects that enhance education outreach:* The Division will pursue memoranda of understanding with other organizations to facilitate education outreach efforts.
- *Exchange or share expertise, personnel, and laboratory facilities:* The Division should encourage or extend agreements with external organizations to transfer expertise and share laboratory facilities to enhance overall scientific productivity and technology transfer as well as expand education outreach.
- *Continue sponsoring post-graduate research fellowships:* The Division has existing partnerships with the National Research Council and the National Institutes of Health to cosponsor post-graduate research at NASA centers. These partnerships should be continued as a way of leveraging government resources.

Objective #7: *Require that individuals responsible for Division-sponsored education outreach programs apply appropriate assessment and evaluation methods:* Assessing the cost-effectiveness of education outreach programs is necessary to determine success.

IMPLEMENTATION STRATEGIES:

- *Ensure the development and implementation of appropriate metrics for Division-sponsored education outreach programs:* The Life Sciences Education Outreach Steering Committee will review the progress and evaluation of education outreach efforts and recommend changes and enhancements. Methods of assessing effectiveness may range from a simple listing of education outreach events to questionnaires about specific activities.
- *Develop a metric for each education outreach implementation strategy:* The Division will identify these metrics, in consultation with NASA Education Program Officers.
- *Convene a meeting of the Life Sciences Education Outreach Steering Committee at least twice a year to report on progress in accomplishing education outreach implementation strategies.*

Conclusion

By leveraging its unique resources, the Life and Biomedical Sciences and Applications Division can use its inspiring mission and outstanding facilities and personnel as effective vehicles for teaching and learning. This approach capitalizes on existing programs to contribute to national educational excellence. The Division intends to leverage and integrate as much of its resources as possible toward achieving the national goal of excellence in education, expanding access to and understanding of activities that can enhance the scientific and technical competence of all Americans. This vision, and the objectives and implementation strategies delineated in this education outreach plan, are a positive step toward fulfilling the Division's obligation to contribute to NASA and national education goals.

Appendix II

Correspondence and Background Material on the NASA Space Life
Sciences-Loma Linda University MOA Signing Ceremony and Luncheon



LOMA LINDA UNIVERSITY MEDICAL CENTER

DEPARTMENT OF RADIATION MEDICINE

November 3, 1994

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Joan Vernikos
Director, Life and Biomedical Sciences
and Applications Division
Code UL
NASA Headquarters
Washington, DC 20546-0001

Dear Dr. Vernikos:

The leadership of Loma Linda University and Loma Linda University Medical Center are pleased to support the development of a NASA laboratory at Loma Linda for the purpose of basic research. We have reviewed the Memorandum of Agreement, incorporating your suggestions, and feel that it is certainly in the best interest of Loma Linda to work with NASA in this manner.

Calvin B. Rock, Chair, Board of Trustees, Dr. Lyn Behrens, President of Loma Linda University, Dr. David Hinshaw, Sr., President of Loma Linda University Medical Center, Dr. Greg Nelson, Jet Propulsion Laboratory, and I will be able to come to Washington to visit with you during your "Life Sciences Week" observance, and celebrate the signing of this agreement on December 1, 1994. If this date is not convenient for your office, we will do all we can to adjust our schedules for another date.

It was a pleasure talking with you and the various NASA investigators for this worthwhile endeavor.

Sincerely,

A handwritten signature in dark ink, appearing to read "J M Slater", with a long horizontal line extending to the right.

James M. Slater, M.D., F.A.C.R.
Chairman and Professor
Department of Radiation Medicine

cc: Walter Schimmerling

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



UL

Reply to Attn of:

NOV 8 1994

James M. Slater, M.D., F.A.C.R.
Chairman and Professor
Department of Radiation Medicine
Loma Linda University Medical Center
Loma Linda, CA 92354

Dear Dr. Slater:

Thank you very much for your letter of November 3, 1994, and for the kind offer on the part of Mr. Rock, Dr. Behrens, Dr. Hinshaw, Dr. Nelson and yourself to visit the Life and Biomedical Sciences and Applications Division on December 1, 1994, during our "Life Sciences Week" observance, for the signing of the Memorandum of Agreement between Loma Linda University Medical Center and our Division.

I believe strongly in the potential of our research to find important application in ways that are not necessarily specific to space, and I look forward to seeing the synergy that will develop between proton radiation biology research applied to space and applied to cancer therapy. I am also delighted that we are agreeing to use the intellectual stimulus of space-related research to contribute to education and training in your medical school. There are many other potential areas of overlap between space life sciences research and medical research, and I hope that a successful collaboration in radiation may lead to further collaborative efforts in the future.

I will be delighted to welcome your delegation on December 1. Could you please advise me of an appropriate time for which to schedule our meeting? I would suggest late morning or noon. If this is agreeable, we could combine our meeting with a joint luncheon. If not, any time on that date will be convenient for me.

I look forward to meeting you again, as well as the distinguished members of your group.

Sincerely,

A handwritten signature in cursive script, appearing to read "Joan Vernikos".

Joan Vernikos, Ph.D.
Director, Life and Biomedical Sciences and
Applications Division

cc:

UL/F. Sulzman

Universities Space Research Association/W. Schimmerling



LOMA LINDA UNIVERSITY MEDICAL CENTER

DEPARTMENT OF RADIATION MEDICINE

November 18, 1994

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Director, Life and Biomedical Sciences
and Applications Division
Code UL
NASA Headquarters
Washington, DC 20546-0001

Dear Dr. Vernikos:

Thank you for your letter of November 8, 1994. I know that you have had several conversations with Stephen Jacobs concerning the exhibit, the signing ceremony and luncheon. I will summarize where I believe we are at this moment, and who is handling what for this event.

The signing ceremony is scheduled for Thursday, December 1, 1994 at noon in the NASA Headquarters lobby. Congressman Jerry Lewis will be present, as well as Dr. Brian O'Connor. Coming from LLUMC is a delegation that includes Dr. David B. Hinshaw, Sr., Calvin B. Rock, Dr. Lyn Behrens, Dr. Jerry Slater and myself. We are also inviting members of our Board of Directors and leaders of the Seventh-day Adventist Church, which is headquartered just outside of Washington, D.C. Gus Cheatham, V.P. of Public Affairs, will be working on the invitations, and we should anticipate approximately 15 people from Loma Linda at the event and luncheon. Mr. Cheatham will be in touch with your office concerning the names and exact number. Stephen Jacobs, and Len Arzt of the LLUMC Washington office, will be dealing with Cong. Lewis, the invitation from Cong. Lewis to Dr. O'Connor, media and logistics.

A LLUMC media announcement of the event has been prepared. I am aware that this was discussed with you and that a copy of this release has been faxed to your office.

Regarding the luncheon, which takes place after the signing ceremony between yourself and Dr. Hinshaw, Sr., I am aware that it will take place in the Office of the Controller of the Currency, next door to NASA, at 3rd and E Streets, on the second floor. I am also aware that it is a buffet luncheon and that Mr. Cheatham will confirm the number of guests we will have attending.

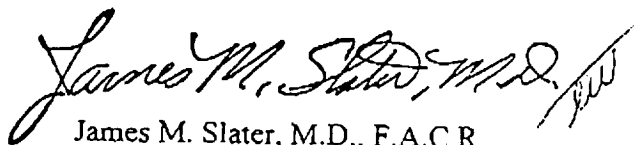
Joan Vernikos, Ph.D.
November 18, 1994

Concerning the exhibit, we have been in touch with Dr. Robert Phillips and will be sending an explanatory exhibit running 10 feet including a video presentation. We have coordinated the shipment of the exhibit with Mr. Daryl Privott in facilities. We will also have information to hand-out, will "man" the exhibit, and will have a person on-site to assist in the set-up.

Dr. Jerry Slater will be present in Washington from the beginning of the Life Sciences Week. I will be arriving on Wednesday, November 30.

I look forward to meeting with you again and working with the distinguished members of your group.

Sincerely,

A handwritten signature in cursive script that reads "James M. Slater, M.D." followed by a small flourish.

James M. Slater, M.D., F.A.C.R.
Chairman and Professor
Department of Radiation Medicine

cc: Walter Schimmerling, USRA

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TELEFAX

For GARY COULTER Date 11-30Affiliation NASASubject Dec. 1 eventFrom Lew Arnt Washington, DC OfficeNo. of pages 2

Phone: 301-913-9360
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Remarks

1. Good News STAY
2. THANKS FR MAP, ET.
3. And your Good Work!



Loma Linda University Medical Center

News Service

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FOR IMMEDIATE RELEASE:

November 17, 1994

Contact:
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Vice President for Public Affairs and Marketing
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Loma Linda University Proton Treatment Center / NASA to collaborate on scientific research projects

LOMA LINDA - Loma Linda University Medical Center will sign a Memorandum of Agreement to establish formal scientific collaboration with the National Aeronautic and Space Administration (NASA) on December 1, at NASA headquarters during the Life Sciences Week activities to utilize the University's Proton Treatment Center to assist in research aimed at protecting astronauts and scientific equipment from the natural radiation of space.

NASA's Life and Biomedical Sciences and Applications Division, within the Office of Life and Microgravity Sciences and Applications, and Loma Linda University Medical Center (LLUMC) will collaborate in the following areas:

- Enhancing basic knowledge of living systems and their response to radiation exposure utilizing the LLU Proton Therapy Synchrotron, to simulate the proton component of the space radiation environment;
- Applying this knowledge to radiation protection, risk assessment, diagnosis, and treatment of cancer; and
- Developing the synergy between NASA research requirements and charged particle therapy to establish a collaborative peer-reviewed research base which benefits the Loma Linda academic community.

more

A Seventh-day Adventist Institution

LLU Proton Treatment Center - NASA collaboration / page 2 of 4

"The Loma Linda University Proton Treatment Center was initially designed to provide for the immediate needs of patients, to expand the scope of cancer treatment with protons, and to explore areas of basic research. The collaboration with NASA in this critical area of space exploration will provide assistance in expanding our research in the exploration of space, as well as benefit our cancer research program at Loma Linda," says James M. Slater, MD, director of the Proton Treatment Center.

Loma Linda University Medical Center is currently the nation's only hospital-based proton treatment center for cancer. In operation for over five years, this center offers a wide array of cancer treatments to patients from across the United States and around the world. The specific advantage of proton cancer treatment is that the characteristic energy distribution of protons can be deposited in tissue volumes designated by the physician in a three-dimensional pattern. This capability provides greater control and precision and, therefore, superior management of cancer treatment.

"The development of proton cancer treatment at LLUMC has proven to be a national medical resource for individuals seeking one of the most effective forms of cancer treatment yet developed," says California Congressman Jerry Lewis, who represents the 40th congressional district. "With over five years of clinical experience and hundreds of patients from across the United States, this new research component to the Proton Treatment Center is a further demonstration of the high technology center of excellence we are creating in Loma Linda."

The main objectives of the LLUMC and NASA effort include:

- Provide access to accelerated proton beams and related research laboratories for NASA-sponsored investigators;
- Provide for contribution of NASA-sponsored investigators to the academic and research programs of Loma Linda University;
- Facilitate transfer of technical expertise between NASA and LLU in the areas of radiation physics and radiation biology.

The NASA Space Radiation Health Program is designed to protect astronauts from radiation in space. This peer-reviewed fundamental and applied research program relates an understanding of basic radiobiology to the effects on humans of space radiation.

LLU Proton Treatment Center - NASA collaboration / page 3 of 4

Protons are a particular concern in the space radiation environment, constituting the most abundant particle species and contributing as much as half of the biologically significant radiation dose to which humans will be exposed to in the space station program and in future missions beyond low Earth orbit.

At LLUMC, clinical use is made of protons for treatment of diseased tissues and structures taking advantage of the medical benefits of proton therapy. The scientific advances made at LLUMC in the use of proton therapy are of direct application to NASA's research into the biological action of energetic charged particles. Conversely, the results of the study of molecules, cells, and animals in space may lead to developments of importance to medicine at LLUMC.

Specific projects in this Memorandum of Understanding include:

- LLUMC will provide proton beam time for NASA researchers. The number of beam-time hours will be determined by LLUMC in a manner consistent with the primacy of clinical and patient requirements;
- LLUMC will appoint a program advisory committee to receive beam time requests and recommend priorities for scheduling available beam time for their use;
- LLUMC will provide dedicated laboratory space for both full-time and visiting NASA researchers. This will provide support for radiation biology research in general and specific proton radiation experiments brought in from other NASA-supported laboratories;
- The costs associated with travel to and use of support facilities during the experiments at LLUMC will be borne out of the research budgets of the investigators;
- NASA scientists accepting beam time will make research results available to LLUMC in the form of preprints, reprints, etc;
- NASA investigators receiving beam time will commit to give at least one seminar on their research at LLUMC, open to faculty and students;
- NASA, recognizing that its scientific research is of great relevance to medical education, will encourage investigators to participate in LLUMC medical education programs, by giving lectures, seminars, and by participating in the Loma Linda educational and research community as appropriate when requested by LLUMC;

LLU Proton Treatment Center - NASA collaboration / page 4 of 4

- NASA investigator teams will endeavor to provide opportunities for participation of LLUMC students and residents to participate in research conducted at LLUMC. Residents participating in NASA research projects will receive academic research credits for such work. LLUMC will make a special effort to identify participants in the LLUMC minority resident program for this activity;
- NASA and LLUMC will collaborate on Loma Linda community outreach educational programs, directed at high schools in the Loma Linda service area, by providing opportunities for students to participate in selected research projects.

No exchange of funds is contemplated with respect to participation by NASA investigators in academic educational and research activities at LLUMC. This does not preclude solicited or unsolicited competitive applications by LLUMC investigators for NASA funding of research projects, nor funding of such projects if competing successfully.

Loma Linda University is a health-sciences institution with schools of medicine, nursing, public health, allied health, and graduate school programs. More than 3,000 students are enrolled from 50 states and 78 countries. Loma Linda University Medical Center is a 1,053-bed teaching and tertiary-care hospital complex serving over 500,000 patients annually. It is the primary clinical site for all the University's academic programs in the health sciences. All areas of medicine are represented from more than 750 staff physicians. The Medical Center participates jointly with the University in all of its national and international programs of teaching and research.

The proton facility is located on two floors, below grade, within the Medical Center. Its modern proton synchrotron provides proton beams of energies ranging from 70 to 250 MeV for eight beam lines entering five shielded rooms. One fixed horizontal beam room is supplied with two beam lines and three rooms house 360-degree rotating gantries for delivering the beam from any angle, all for patient treatment. A fifth room contains three fixed horizontal beam lines for physics, engineering, and biology research.

Loma Linda University and Loma Linda University Medical Center are owned and operated by the Seventh-day Adventist Church.



SAN BERNARDINO
COUNTY

The Sun

Wednesday, November 30, 1994
San Bernardino, California

LLU and NASA join hands on project

By Jim Speer
Sun Washington Correspondent

WASHINGTON — NASA researchers plan to use Loma Linda University's futuristic Proton Treatment Center to find ways to protect astronauts from radiation in space, agency and university officials said Tuesday.

The National Aeronautics and Space Administration hopes to discover the effects of radiation on living organisms and scientific equipment through simulations using nation's only hospital-based proton treatment center for cancer, officials said.

NASA administrator Daniel Goldin and other top scientists will host officials from the university at a Washington ceremony on Thursday to create the partnership to use the \$45 million facility for radiation research.

SPACE

"The (center) was initially designed to provide for the immediate needs of patients, to expand the scope of cancer treatment with protons, and to explore areas of basic research," center director James M. Slater said in a press release. "The collaboration with NASA... will provide assistance in expanding our research in the exploration of space, as well as benefit our cancer research program at Loma Linda."

The contract won't affect the 45 patients a day who are treated at the proton center, said Anita Rockwell, a medical center center spokeswoman. NASA will work after hours, she said.

The program does not involve experiments on human subjects, and will not add jobs or funding for the proton program. But uni-

versity officials said they are excited by the continuing attention for a program that already has been well-funded by Congress.

Through the efforts of Rep. Jerry Lewis, R-Idaho, the university in 1992 received a \$10 million grant to help create the research center for use and expansion of the proton treatment program. The university also received a \$5 million grant this year for a program to train displaced defense industry personnel in medical technology.

"With over five years of clinical experience and hundreds of patients from across the United States, this new research component to Proton Treatment Center is a further demonstration of the high technology center of excellence we are creating in Loma Linda," Lewis said.

The three-story center at the medical center uses a stream of

accelerated protons to treat cancers of the eye and others that require extremely precise, high-powered radiation.

NASA scientists hope to study scientific advances made at the center, which could provide breakthroughs in the kind of radiation protection needed in space, they said. They also will use the equipment for controlled experiments not involving human subjects.

Loma Linda researchers and students will benefit in return from the opportunity to take part in this research, and from the potential to apply it in further medical uses of accelerated protons, they said.

The university and agency also plan to collaborate on community educational programs for area high schools and provide students a chance to participate in selected research projects.

Redlands Daily Facts

Thursday, December 1, 1994
Redlands, California

LLUMC facility will help NASA research solar flares

By CLYDE WEISS
Redlands Daily Facts
Washington Bureau

WASHINGTON — Used for several years to treat certain types of cancer, Loma Linda University Medical Center's Proton Treatment Center will soon become a tool for NASA researchers who want to understand how radiation affects astronauts traveling through deep space.

NASA Administrator Daniel S. Goldin, Loma Linda University Medical Center President Dr. David B. Kinschew and Rep. Jerry Lewis, officials who presided this morning over the signing of an agreement to permit NASA researchers to use the proton facility during the next five years for basic research,

"This is going to have a huge impact on the space program," said Goldin. "This is the ultimate technology transfer."

Without Loma Linda's proton beam accelerator, he added, "the space program would have been in trouble."

"I couldn't be more excited," said Lewis, who will become chairman next year of a House subcommittee that will set spending priorities for NASA. Lewis, conscious of demands to cut the federal budget, emphasized the NASA project "is going to cost a lot of money, but it is going to save a lot of lives."

The collaboration between NASA and the 1,051-bed university medical center, owned and operated by the Seventh-day Adventist Church, will not affect the center's treatment of cancer patients, officials said. The

medical center will deactivate how much proton beam time it will provide to NASA researchers.

The agreement signed today will permit NASA-funded researchers to use the hospital's proton facility to simulate the proton radiation emitted by the sun during solar flares.

The basic research will not be done on human subjects, although it will involve living human tissue cultures and mice.

Dr. James Slater, director of the proton center, said human cells obtained from biopsies "continue to grow indefinitely," and will be used in experiments involving low-dosage radiation.

Slater said a simulated space capsule will be set up at the proton center to show the proton radiation is affected when it passes through various electronic devices found in

spacecraft. "Everything that previous pass through creates different types of radiation," he said. "We want to see precisely what goes on" in such an environment.

Joan Varnhoken, director of NASA's Life and Biomedical Sciences and Applications Division, said this will be the first time a proton beam accelerator will be used to simulate the effect of proton radiation in space on living human tissue cultures.

"Protons are almost one-third to one-half of the radiation in space" that emanate from solar flares, she said. Although such flares are rare, perhaps one a year, they cannot be easily predicted and thus avoided, she said.

Learning how to protect astronauts from such flares is critical, said

astronaut Bryan O'Connor, who piloted a shuttle mission in 1985 and was commander of another, STS-40, in 1991.

"I'm not too worried about solar flares in low-earth orbit," said O'Connor, whose family lives in Twentynine Palms. "It's more an issue when you go to Mars or the moon" beyond the protection of the Earth's magnetosphere.

"If there's some way we can cause protons not to affect human tissue ... that's the kind of research we're interested in," he said.

The Loma Linda proton beam center is the nation's only hospital-based proton accelerator, which allows physicians to direct a stream of electrically charged subatomic particles to a specific point in the body to kill cancer cells without harming surrounding healthy tissue.

Appendix III

Public Information "One Pagers" Developed by the CSU Team for Use by the
LBSAD and Administrator Goldin



SPACE LIFE SCIENCES

Women's Health and NASA Life Sciences Research

Life sciences ground-based and space-flight research programs are making important contributions to health care and medical science. Over the years, NASA has performed and supported research related to the physiological function of both men and women. Certain research directions are of particular value to women's health because they address areas in which women are more vulnerable. The following are examples.

Osteoporosis

During space travel, astronauts experience a rapid loss of bone mass. Osteoporosis is also a problem that accompanies aging—more so in women than in men (5:1 ratio). NASA and the National Institutes of Health currently are working to develop ways of preventing and treating space-flight-induced bone loss, ways that can be applied also to the fight against osteoporosis on Earth. In the course of these studies, NASA researchers have developed technologies that are finding Earth-bound uses. For example, an instrument designed to non-invasively analyze bone density and fracture risk is being used clinically in studies of women who suffer from post-menopausal osteoporosis.

Cancer

NASA's Johnson Space Center has teamed up with Caltech/JPL, industry, and the National Cancer Institute to develop a method for identifying and quantifying the degree of atypia (abnormality) in human lung epithelial cells. The resulting technology has made possible earlier detection of lung cell damage that might lead to cancer. More importantly, this technology is now being used for automated analysis of cervical cell samples taken for women's PAP tests. This technique can result in earlier and more reliable diagnosis of cervical cancer. Currently, two vendors (PAPNET and CYTEC) are seeking FDA approval for routine analysis with their automated cytology machines.

Studies supported by NASA are helping our understanding of the development of cancers. State-of-the-art biomedical facilities, developed by NASA to mimic the effects of weightlessness, have been used to grow cancer cells that resemble those growing in the human body. This gives researchers opportunities to more closely study the cancer cells and to test new treatment therapies.

Radiation Effects

Endometriosis, an abnormal proliferation of the lining of the uterus, afflicts up to 10 percent of women and 25 to 40 percent of infertile women. A NASA/Air Force program to study the effects of space radiation revealed that animals exposed to radiation had double the incidence of endometriosis (53 percent). The information gained in this study will help us to understand the broad effects of radiation on women and as well as the specific causes of endometriosis.

Other studies on the radiation environment of space are leading to a better understanding of the long-term effects of even low exposures of radiation. As a result, we are contributing to significant improvements in radiation therapy.

Biological Rhythms

Women make up the majority in many occupations that rely on night duties or shift work (nursing, flight attendants, etc.), which greatly affect the body's biological rhythms and menstrual cycle. In turn, these natural rhythms and cycles affect sleep and performance. Because there is compelling evidence that space flight disturbs sleep and biological rhythms, space life scientists are working to better understand and trace these disturbances and to find ways to lessen the negative effects on personal performance and well-being. One investigator, Dr. Charles Czeisler (Brigham and Women's Hospital) is studying the use of bright light to reset the human biological clock.

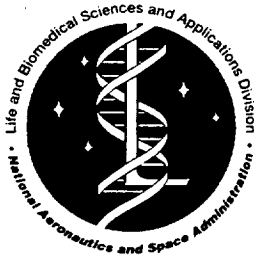
Blood Pressure Control

Cardiovascular disease in women has long been neglected as a major health risk. NASA's work in understanding how space flight affects blood pressure controls in both men and women is helping scientists understand the complex operation of the heart and circulatory system. In weightlessness, the body's blood pressure controls are altered. For astronauts, this means that when they return to Earth, they suffer from low blood pressure. For the general population, both high and low blood pressure problems exist. NASA-funded research has led to the development of an instrument that is now used in clinics to evaluate patients' blood pressure control (the Baroreflex Cuff).

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SPACE LIFE SCIENCES

Implantable and External Pumps

Background

Insulin-dependent diabetics have been aided by the use of space technology in the development of both external and implantable (internal) insulin delivery systems. In these devices, a computerized pump serves as an artificial pancreas that provides insulin to the body at a controlled rate. These insulin pumps provide precise control of blood sugar levels without which conditions such as blindness and kidney disease could result. The diabetic is also freed from the burden of daily insulin injections.

NASA's Involvement in Product Development

The Programmable Implantable Medication System (PIMS) resulted from efforts begun at NASA's Goddard Space Flight Center to transfer aerospace technology to the medical field. Created by the Applied Physics Laboratory of Johns Hopkins University, in cooperation with Goddard and MiniMed Technologies (CA), a manufacturer of medical equipment, the PIMS is surgically implanted in the diabetic's abdomen to continuously deliver insulin.

The implant consists of a refillable reservoir, a pumping mechanism, a tube leading to the diabetic's intestines, a microcomputer, and a battery—all encased in a titanium shell three inches in diameter and three-quarters of an inch thick. The pump's tiny dimensions are the product of NASA's expertise in miniaturizing components for satellite use. NASA technology also helped create the pumping mechanism, which is based on a design developed for the Mars *Viking* lander. The energy efficient, battery-powered device delivers insulin into the abdominal cavity in short "pulses." When an insulin refill is needed, it can be accomplished without surgery using a special hypodermic needle. By holding a small radio transmitter over the implant and selecting one of 10 preprogrammed codes, the diabetic can change the infusion rate or ask for a supplemental dose of insulin before meals or when blood sugar levels are elevated. Another code allows the physician to access information from the pump's stored memory, reprogram insulin delivery, and generate computer records of pump performance.

The MiniMed® 504 insulin infuser pump is a device similar to the PIMS, but is worn externally. Also based on NASA-developed technology, the MiniMed 504 can be clipped to any part of the user's clothing and worn around the clock. About the size of a credit card and weighing just 3.8 ounces, it houses a computer, a battery, and a syringe filled with insulin. The syringe is connected to a thin, flexible plastic tube about 30 inches long with a needle at its end. The patient inserts the needle just under the skin, and insulin is administered at rates determined by the patient's needs, as controlled by the computer.

Technology Benefits of Implantable and External Pumps

- They provide insulin or other medications to the body at a controlled rate.
- They eliminate need for daily insulin injections.
- Both the patient and the physician can adjust the insulin delivery rate using bidirectional telemetry—a technique developed by NASA to communicate between spacecraft and Earth receiving stations.
- New improved medical technologies enable people to live longer with a better quality of life.
- Fewer, shorter hospitalizations, less need for surgery, intensive and long-term care, and other benefits of the innovative application of NASA-developed technologies reduce pain and suffering and the cost of health care for everyone.
- Technology commercialization ensures “benefit-driven development” of NASA technologies. LBSAD’s goal is to ensure the smooth and efficient transfer of greater numbers of NASA-developed technologies to the economic benefit of the American public.

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SPACE LIFE SCIENCES

Spinal Bracing

Background

Sandra Wafer is a dancer with the City Ballet of Houston, Texas. A few years ago, this young ballerina's dream of dancing seemed extremely remote; she was a victim of scoliosis, a disease characterized by progressive curvature of the spine. But Sandra Wafer escaped the crippling deformities of scoliosis by means of a new course of treatment that focuses on innovative bracing techniques as an alternative to surgical correction. The key element of the treatment is use of the Copes Scoliosis Brace, developed by orthotist Dr. Arthur L. Copes of the Copes Foundation, Baton Rouge, Louisiana.

Benefits

The Copes brace, fabricated to a patient's specific need, features a novel pneumatic bladder that exerts corrective pressure on the spinal curve. A typical brace may employ as many as six pneumatic bladders, which are technically known as force vector pads, to apply pressure along the deformed spinal curve; each contains a valve system that enables the treating physician to alter the pad pressures. Through constant corrective force applied to the torso, distortion is slowly reduced or eliminated by periodic air injection into the force vector pad.

In addition to long-term use of the brace, the Copes Scoliosis Program includes a three-phase exercise course, hydrotherapy, bone manipulation, and muscle stimulation. Once a patient achieves maximum correction, he or she is introduced to a retainer brace. The length of a complete program naturally varies with the individual, but usually the patient wears the corrective brace for 14 to 18 months. Correction to some degree is accomplished in more than 80 percent of the cases, according to Dr. Copes. Sandra Wafer began treatment with two 30-plus degree spinal curves; after two years of treatment, the curves were reduced below five degrees.

NASA Contribution

Dr. Copes credits NASA technology transfer with an assist in his development of the Copes Scoliosis Brace. He was helped by the NASA/Southern University Industrial Applications Center, Baton Rouge, Louisiana, and the Central Industrial Applications Center, Durant, Oklahoma, whose jobs were to provide information retrieval services and technical help to industrial and institutional clients. The two centers supplied Dr. Copes with more than 50 technical reports from the NASA data bank and other databases; they covered a variety of subjects, such as other types of braces in use, the effects and complications of bracing and surgery, and technology developments in rubber and plastics applicable to both the brace and the pneumatic bladder. Dr. Copes states that roughly 35 percent of these medical reports had a vital degree of utility in his development effort. He adds that the NASA input contributed significantly to the achievement of extraordinary results in hundreds of patients.

(Over)



SPACE LIFE SCIENCES

Maintaining Bone Density through Exercise

Background

Astronauts in space and bed-rest patients on Earth have something in common—a reduced demand on their muscles and bones to perform daily activities. This reduction in weight-bearing activities results in reductions in bone density and muscle mass in the lower extremities of both groups. NASA has a special interest in developing ways to measure and understand this bone and muscle loss and in devising countermeasure exercises to ameliorate these changes.

Currently, NASA astronauts and Russian cosmonauts spend a portion of each day in space exercising on stationary bikes and on treadmills in an attempt to mimic the weight-bearing activities experienced on Earth. These aerobic exercises have helped to lessen some of the adverse cardiovascular changes that occur during spaceflight, but apparently do not provide sufficient loading of the muscles and bones to prevent them from getting smaller. Effective and time-efficient countermeasures are still being sought to help prevent bone and muscle loss.

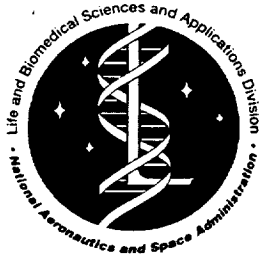
Ongoing Research

As part of a broad effort to better understand how exercise can be used to maintain bone mass in astronauts, NASA researchers have conducted several studies to evaluate the effects of different types of physical activity (e.g., walking, cycling, and swimming) on the body's bones. During the studies, researchers measured and recorded bone mineral density of several representative bones (e.g., heel, femur, and lumbar spine) of the study participants. These studies concluded that walking exercises and exercises that do not provide high loads to the lower extremities did not contribute to the maintenance or buildup of bone mineral density in the body. The studies showed instead that the exercises involving high loads were best for enhancing bone mineral density.

NASA research continues in this area to better understand and characterize the physiological effects of weightlessness and inactivity on the human body.

Benefits

These research findings are important for those working to maintain the health and well-being of both astronauts in space and elderly or bed-ridden persons on Earth. Both suffer physiological effects due to inactivity. With better insight into the relationship between exercise and bone density, appropriate exercises can be prescribed to increase, or at least minimize the decrease of, bone mineral density and bone strength.



SPACE LIFE SCIENCES

Cool Suits

Background

Whether walking on the Moon or servicing the Hubble Space Telescope, working in a space suit is very hard work. In order to remove the perspiration and body heat an astronaut generates, NASA has developed a Liquid Cooling Garment (LCG) which is worn under an astronaut's space suit. The LCG worn by today's astronauts is a zippered one-piece suit made of stretchable material, called Spandex™, laced with over 270 feet of plastic tubing. Chilled water circulates through the plastic tubes to cool the astronaut. Hollow tubes that run down the back, arms and legs of the suit draw perspiration away from the crew member.

Benefits

Health: People born without any of the sweat glands needed to reduce body heat can develop heat stroke during physical exercise or when exposed to warm temperatures. People without sweat glands in certain areas of the body may develop body sores and may eventually require amputation of arms or legs. These individuals can avoid overheating and live relatively normal lives by using commercially available products that use cool suit technology originally developed by NASA.

For example, an LCG adapted for a young boy without sweat glands by Life Support Systems, Inc. (Mountain View, CA), consists of a helmet liner and vest that fits comfortably beneath the boy's clothes. A portable, battery-powered refrigeration unit pumps cooled antifreeze solution through tubes to the garment, carrying away body heat and helping the boy's heart and lungs function normally.

Workplace Safety: Based on a NASA design, ILC Dover, Inc. (Frederica, DE) has developed a completely portable, fully insulated cooling garment (Model 1905 Cool Vest™) to maintain worker comfort and safety when exposed to extremely warm temperatures for extended periods of time. Chilled water circulated by a battery-powered pump throughout the Cool Vest prevents heat stress and keeps workers cool and productive. ILC has combined the LCG concept with other NASA life support technologies to develop extremely rugged and compact systems that provide safety and support life in high temperature industrial environments.

In 1971, NASA's Ames Research Center awarded a contract to Acurex Corporation for an extension of technology used to develop a liquid-cooled helmet liner for helicopter pilots. In agricultural states, most crop dusting is done in the late afternoon or evening, after the crop dusting aircraft has been exposed to hot sunlight for hours and the cockpit temperature may be as high as 125 °F. Cockpit heat is a major problem for the professional crop duster because elevated body temperature can cause fatigue, dehydration, and even collapse, extremely dangerous consequences to a pilot flying only two to four feet above the vegetation. SSI of Mountainview, CA, has developed a lightweight vest unit called the Cool Head System™. With Cool Head, most body heat storage can be eliminated and the pilot's heart rate can be lowered, increasing the personal safety of people in this very hazardous occupation.

(Over)

Appendix IV-A

Short Summary of 1993 Activities and Accomplishments in Space Life
Sciences Provided to NASA Managers by the CSU Team for Inclusion In the
Annual LBSAD Accomplishments Document

<p>1993 ACTIVITIES AND ACCOMPLISHMENTS IN SPACE LIFE SCIENCES Life and Biomedical Sciences and Applications Division (LBSAD) Code UL</p>

- 1) The new Division (Code UL) leadership has instituted procedural, programmatic and organizational changes which reflect renewed emphasis on studies of the gravity sensing and response mechanisms of living organisms. In addition:
 - All NASA advanced life support, human factors engineering, and biomedical technology development programs have been consolidated within the LBSAD to increase emphasis and programmatic efficiency.
 - Exobiology, the High Resolution Microwave Survey, Biospheric Research (except global monitoring for disease prediction) and the support of Operational Crew Health were transferred to other NASA Headquarters organizations.

- 2) To ensure that the highest quality science is supported and that all semblance of conflict of interest is eliminated, the Division is strengthening and streamlining its procedures for peer review and management of proposals for research and technology development.

All extramural research within LBSAD is now solicited under a single annual NASA Research Announcement (NRA). Intramural research will be programmatically and operationally focused and customer oriented. To maintain uniformity, the same extramural peer panels will review both extramural and intramural proposals.

- 3) Under the auspices of the U.S./Russian Joint Working Group on Biomedical and Life Support Systems, the Telemedicine Implementation Team initiated a second telemedicine demonstration project using satellite communications between four medical institutions in the U.S. and one in Russia. In November, the project, known as "Spacebridge to Moscow," was inaugurated with the support of Senators Rockefeller and Mikulski as well as Representative George Brown.

- 4) Spacelab Life Sciences-1 (launched June 5, 1991; 9 day mission) was NASA's first dedicated space life sciences mission. Selected science, aimed primarily at confirming theories and validating data from ground-based investigations, focused on the underlying biological mechanisms of adaptation to microgravity and readaptation to unit gravity. Although data reduction and analysis are ongoing, the following results are already available:
 - Cardiovascular adaptation to the microgravity environment apparently begins much sooner than was expected and the nervous and endocrine systems play a more significant role in that adaptation than predicted.
 - As expected, impairment of baroreflex function, measured for the first time during spaceflight, contributes to the dizziness and postural instability astronauts encounter upon reentering the Earth's gravitational field.
 - In-flight measurements revealed that regional differences in the lung's blood flow and gas exchange may not be as gravity dependent as predicted.

- 5) The German Spacelab Mission D-2, which included 3 NASA space life science studies, was successfully flown in April, 1993.
 - Results from these studies increase our understanding of the baroreceptor-cardiac reflex. Experiments on D-2 confirmed the theory that postflight orthostatic intolerance arises because the normal reflex system regulating blood pressure becomes less sensitive in a microgravity environment.
 - Equipment developed by NASA to support this investigation is currently being produced commercially to help diagnose causes of orthostatic hypotension in patients.

- 6) The highly successful Spacelab Life Sciences-2 (STS-58) mission set records in flight duration and science return. The mission also included the first inflight animal tissue collection.
 - Virtually flawless performance by the crew, hardware, and support teams.
 - 99.1% of 452 time-lined data collection and subject procedures were successfully completed; 54 unscheduled procedures further enhanced the science return.
 - Data being analyzed promise to change our concepts of the role gravity plays in lung perfusion, the development of anemia and our ability to maintain posture and balance.
- 7) Cosmos 2229 (Bion 10) successfully completed an 11.5-day mission on January 10, 1993, with 11 U.S. investigators participating in bone, neurovestibular, neuromuscular, circadian rhythm, metabolic, and immunological studies. Final science reports will be presented at a December, 1993, symposium in Moscow.
- 8) 160 proposals from the U.S. and fourteen other countries were received in response to the Announcement of Opportunity (AO) for Neurolab (SLS-4) which will fly in 1997. This NASA-NIH international mission serves as a model for scientific cooperation on Space Station.
- 9) NASA and NIH continue to expand and pursue promising areas of collaborative biomedical research and technology development.
 - MOUs now exist with seven Institutes of the NIH.
 - A Center for Vestibular Research is jointly funded.
 - A Center for Integrated Physiology is jointly managed.
 - Ground-based research with individual investigators is jointly funded.
 - Five Institutes are participating in Neurolab (SLS-4).
 - Unique NASA ground facilities are being made available to NIH supported investigators.
 - NASA and NIH are jointly sponsoring a minimum of five Space Shuttle experiments per year, beginning with STS-59 in March 1994.
 - New access through the National Library of Medicine at NIH will allow investigators worldwide to search publications from all NASA Life and Biomedical Sciences flight and ground based research and technology programs. Citations from current and past efforts are being added continuously to a new cooperative bibliographic database.
- 10) Expanded cooperative programs with the National Science Foundation (NSF).
 - Developed prototype crop growth and waste processing technologies for installation in NSF facilities at the South Pole and for future advanced life support systems.
 - New MOU establishes a joint Plant Biology program.
- 11) The Division played a leading role in International Space Life Sciences Strategic Planning Working Group (ISLSSPWG) activities with CNES, CSA, DARA, ESA, and NASDA. A flight research strategic plan being developed includes the use of Russian space facilities and a comprehensive international inventory of existing and planned life science flight hardware that can be used on Space Station.
- 12) The Division's educational programs are being refocused to target K-ninety coverage and to develop new creative ways of stimulating excitement in the Space Life Sciences.
 - The Space Life Sciences Training Program (SLSTP) graduating class included students from 24 states, and 14 different college majors. Forty percent were minority students, and over 50-percent were women.
 - Successful pilot program with 7,000 high school students resulted in jointly sponsored effort with NIH to revise "Human Physiology in Space" text.
- 13) Ground-based research programs have produced significant data and technologies with direct applicability on Earth.

- Improvements in medical imaging technologies and advanced cardiovascular sensors
- A new Galactic Cosmic Ray model with improved precision reduced prediction uncertainties from $\pm 50\%$ to $\pm 10\%$.
- Studies of cancer development in mice have shown that high Linear Energy Transfer (LET) radiation found in space tumors with greater malignancy than low-LET, x-rays and gamma-rays.
- The Advanced Life Support Program has developed a process which reduces formation of biofilm (microbial growth on surfaces). In response to strong commercial interest this technology is being patented.
- Space Human Factors program computer simulation was used to improve fidelity and decrease time required for crew training for Hubble Space Telescope repair.
- Developed techniques using Earth observing satellite data for more efficient and cost effective Malaria-bearing mosquito control, and for mapping risk of Lyme Disease.
- An instrument developed by a NASA/Stanford collaboration to measure bone strength was built for commercial use under the Small Business Innovative Research program.

Appendix IV-B

**Summary of Highlights of Space Life Sciences-Supported Research with
Applications in Medicine and Health Care Prepared with the Assistance of the
CSU Team for the Office of the NASA Administrator**

**Highlights of Space Life Sciences-Supported Research with Applications
in Medicine and Health Care**
March 27, 1995

- **TELEMEDICINE:** NASA is a pioneer in the development of the emerging fields of telemedicine and medical informatics. Multiple advanced medical technology development programs include important contributions to:
 - remote health care,
 - portable imaging,
 - portable clinical analysis and therapeutic devices,
 - computer medical informatics, and
 - noninvasive diagnostic techniques.
- **BIOTELEMETRY:** NASA-sponsored research has contributed significantly to the development of biotelemetry, a method whereby physiological data are converted into signals and sent to medical monitoring personnel from remote locations. It is now used routinely for monitoring patients in hospitals, ambulances, or small geographically isolated clinics. For example:
 - A switch developed for activating switches in a spacecraft guided by movement of the astronaut's eye was adapted to aid paralyzed people. Utilizing biotelemetry, the sight switch can manipulate wheelchairs and send emergency signals to hospitals, and is used in home alarm systems. It was tested and approved at the Rancho Los Amigos Hospital in **Downey, CA.**
- **MEDICAL IMAGING:** Use of the "CAT" scan has revolutionized diagnostic imaging. The CAT scan is based on digital image analysis techniques developed by the NASA-funded Caltech/ Jet Propulsion Laboratory to analyze images of the planets. The CAT scan (now referred to as computed tomography, or CT) reconstructs a "slice-like" image from the multiple views obtained by a fan-shaped X-ray beam without the use of ionizing radiation.

NASA image enhancement software developed at JPL has been combined with equipment modifications and techniques developed at JSC to create a unique digital analyzing microscope. This system has been used in collaboration with the National Cancer Institute, to document and quantify the progression of lung epithelial cells from the normal to the cancerous state. This technique has been adapted for routine screening of cervical cancer cells in women as an improvement to the well known PAP smear.
- **LIXISCOPE INSTEAD OF X-RAYS:** NASA researchers developed a lixiscopescope (a portable X-ray intensifier) which is fully portable and utilizes a weak radiation source to image the internal body. The lixiscopescope reduces the radiation dose to less than 1 percent of that generated by standard X-rays. With important applications in medical and dental fluoroscopy, the compact, portable system can be used in the homes of the bedridden and physically disabled and is ideal for use with battlefield injuries, at sporting events and emergency situations in remote areas.

- **PROGRAMMABLE PACEMAKER:** The non-invasive system consists of an implantable pacemaker together with a physician's console containing the programmer and a data monitor/printer. The physician reprograms the patient's pacemaker using wireless telemetry signals.
- **AUTOMATIC IMPLANTABLE DEFIBRILLATOR:** Each year, nearly 50,000 Americans die within a year of "recovery" from a heart attack. The fatality is usually associated with onset of ventricular defibrillation. A companion instrument to the programmable pacemaker, the implantable defibrillator senses cardiac arrhythmias and automatically delivers an appropriate electrical stimulus to restore the normal electrical activity of the heart.
- **AUTOGENIC FEEDBACK:** Paraplegic or other immobilized patients who faint when they first sit up have used the method of "Autogenic Feedback Training" developed by NASA's Dr. Patricia Cowings through which they (and space crewmembers) have learned to overcome symptoms by consciously controlling autonomic body functions (e.g., blood pressure).
- **BONE LOSS:** NASA and university researchers have discovered that certain types of exercise (high-load, low repetition) performed for 30 minutes twice a day prevent the loss of calcium from bone induced by inactivity (bedrest). Other exercise regimens had no such effect. This research has shown that muscle strength is closely related to bone mineral density, so that procedures enhancing one may also enhance the other.
- **MUSCLE REHABILITATION:** The dynamic inter-limb resistance exercise device developed by NASA researchers strengthens muscle groups in the arms, legs, and back. This hardware is well suited for use in confined settings on Earth and in space, for retraining after sports injuries and muscle conditioning for the disabled.
- **PHARMACOLOGY:** Operationally-oriented biomedical research has led to the development of new drugs and diagnostic tools for gastric dysfunction and treatments for motion sickness and nausea and to the development and patenting of an intranasal dosage method for delivering antimotion sickness medication.
- **COOL SUITS:** liquid-cooled garments based on space-suit technology have helped individuals born without sweat glands as well as those who suffer from Multiple Sclerosis. The garments are also used in studies of cancer therapies. Variations of the garment have helped the disabled tolerate heat stress and are broadly applied within the fire fighting community.
- **NEUROVESTIBULAR PHYSIOLOGY:** Development of hardware and diagnostic tests for neurovestibular (inner ear) and postural disorders and musculoskeletal changes associated with spaceflight has led to a better understanding of sensorimotor systems responsible for maintaining upright posture and gait which are being applied to the field of gerontology.

- **HEALTH INFORMATION MANAGEMENT SYSTEM (HIMS):** Physicians at the Kennedy Space Center developed a computerized, networked database that fully automates the KSC health care records system and allows the user to simultaneously search multiple sources of managerial and medical information. Laboratory test results, hazardous worksite conditions, and characteristics of disease signs or symptoms aiding in medical diagnosis and prescription of therapy or procedures.
- **LIQUID AIR SELF-CONTAINED BREATHING APPARATUS -** A Liquid Air Pack has been developed to meet unique needs of astronaut rescue. This device provides at least 45 minutes of positive-pressure breathing support to vigorously working rescuepersons. There are currently 38 such units in place for Shuttle launch and landing activities. Efforts are underway to commercialize this technology, as it offers at least twice the breathing duration of civilian units of similar weight and size.
- **RADIATION MONITORING:** The Radiation Biology Program has funded development of active radiation monitors capable of measuring real-time linear-energy transfer (LET), charge, and energies of protons and heavy ions in space. Information from these monitors will be essential for determining individual organ doses for health risk assessment. The instruments are broadly applicable within the nuclear industry.
- **ENVIRONMENTAL TOXICOLOGY:** In cooperation with the National Research Council's Committee on Toxicology, NASA toxicologists have set and documented continuous exposure limits for 30 contaminants important in the control of spacecraft air quality. The methods developed during this cooperative effort have established scientifically-based limits with unprecedented detail and precision.
- **BONE REMODELING:** Space life sciences researchers have developed a remodeling theory of bone that accounts for independent effects from all load cycles imposed during daily activity on bone remodeling, thus yielding a non-linear system formulation with important results and applications. In addition to stimulating new avenues of basic research, the model has been applied by others to the evaluation of orthopedic implant designs, the influence of exercise on bone density, and to age-associated bone loss.
- **NON-INVASIVE BONE ANALYZER:** Space life sciences-funded researchers have developed a microprocess-controlled probe that induces vibration in bones, measures displacement and computes stiffness and effective mass of the bone. The device is equally applicable to the study of osteoporosis-induced decreases in stiffness and mass in terrestrial patients.

- **INTRACRANIAL PRESSURE:** Headaches may be caused by elevated intracranial pressure (ICP). A NASA-developed device used in studies that simulate weightlessness provides a useful method for diagnosing and treating patients with increased ICP due to head trauma, brain tumors, and strokes
- **BACK PAIN:** The majority of astronauts and bedridden patients suffer from low back pain. Both groups will be helped by a spinal compression harness developed by NASA scientists in collaboration with **Acromed, Inc. (OH)**, and **Donjoy, Inc. (Carlsbad, CA)**. The harness is providing a better understanding of the biomechanics and the basic mechanisms of back pain.
 - Posture and gravity can alter the swelling of the intervertebral disc. NASA researchers have designed and tested a new device that provides a rapid, direct, and accurate measurement of disc swelling. The insights may help those who suffer from lower back pain, disc degeneration, and intervertebral hernias.
- **FIGHTER PILOTS:** G-Induced Loss of Consciousness (GLOC) takes a severe toll on fighter pilots during high performance maneuvers. Navy and Air Force fighter pilots will benefit from NASA life sciences-funded studies of the velocity of blood flow to the head, indicating how lower body straining maneuvers allow humans to tolerate high gravity forces. These studies led to the commercial development of a transcranial doppler to measure blood flow velocity in the head (**Medasonics, Inc., Fremont, CA**) which warns pilots of dangerous G-loads .
- **SELF-CONTAINED ATMOSPHERIC PROTECTIVE ENSEMBLE GARMENT:** At KSC, fuel handlers are protected by a self-contained whole body suit when working with toxic rocket propellants. These "SCAPE" suits are impervious to most toxic materials and have application to hazardous material clean-up and response. The suits provide respirable air and cooling for at least two hours. Conventional and rapid decontamination and reuse of the suit is possible. Transfer of this technology to civilian haz-mat response units would provide a dramatic increase in useful on-station time.

In addition, Space life sciences-funded NASA researchers, contractors and university-based investigators have developed or contributed significantly to the development of:

- a **cardiology mannequin** used in medical education that simulates 40 heart conditions ,
- an implantable **human tissue stimulator** that provides electro-stimulation of tissue for relief of chronic pain and other applications,
- **electrode-based electrolyte analyzers** to instantaneously determine the ionic composition of fluids used in science and industrial processes,

- **an aseptic fluid transfer system** that allows the transfer of medically required fluids between containers in a sterile manner,
- **an automated digital light microscope**, used for accurate and reproducible chromosome analysis, sold commercially as the PSICOM 327® system by Perceptive Scientific Instruments, Inc.
- an automated, computer-aided system used for **muscle tissue analysis**,
- **an eye movement tracking device** that incorporates laser technology and is used in retinal surgery,
- **a biotelemetry system for gait analysis** used to design and evaluate therapies in stroke and cerebral palsy patients,
- **an ocular screening system** for detecting visual abnormalities early enough that treatment is effective,
- **a biotelemetry package** that speeds recovery from hip replacement surgery,
- a sensitive technique for recording and analyzing human respiratory sounds that allows rapid **non-invasive lung diagnosis**,
- an **ATP photometer** which enables a rapid and accurate enumeration of bacteria in body fluids and industrial fluid samples,
- a one-step **liquid-liquid extraction technique** used for separating chemical compounds in body fluid samples;
- the FITLOS **computer program** for rapidly analyzing biological samples,
- **a portable Medical Status and Treatment System** for use by paramedics in remote areas,
- **a portable heart rate monitor** to facilitate the diagnosis and treatment of heart conditions,
- **a Bone Stiffness Analyzer** used in the early diagnosis of osteoporosis,
- digital image processing technologies used commercially in the **evaluation of skin care products**,
- a system for **precise evaluation of posture and balance disturbances** used for the diagnosis of neurological and musculoskeletal disorders,

- an ingestible **Thermal Monitoring System**, a capsule swallowed by the patient, which monitors body temperature as it passes through the body,
- a **Thermal Video System** for heat detection, used in diagnosis of burn severity and to image breast tumors and cancerous tissue,
- an **Advanced Sterilization System** used for medical instruments,
- **fiber optic imaging equipment on catheters** used in balloon angioplasty were developed from digital imaging systems used in Earth-monitoring satellites and deep space probes,
- **advanced methods of image processing** developed for computer assisted tomography (CAT) scans; magnetic resonance imaging (MRI); Positron Emission Tomography (PET),
- an **advanced dental arch wire material** which provides greater elasticity than stainless steel wire currently in use,
- a **programmable remapper** image processing machine for aiding the visually impaired,
- an **ultrasound echocardioscope** used to monitor cardiac function in infants, children, and adults,
- **advanced computer imaging** techniques used in detecting arteriosclerosis,
- improved **long-duration storage techniques** for white blood cells and bone marrow,
- an improved **infant transport monitoring system**,
- a system for **automated blood pressure measurement** with readings that appear automatically on a digital display,
- a **tympanic membrane displacement analyzer** for the non-invasive measurement of intracranial pressure,
- a **spinal compression harness** to improve the understanding of spinal biomechanics and alleviate back pain,
- a **colloid osmometer** which provides direct, rapid and accurate measurement of swelling pressure of the intervertebral disc,
- an advanced **microscope and micropipette** to record pressure in the capillaries,

- a **fiber-optic** "transducer-tipped" catheter to directly record intramuscular pressures,
- a **wick catheter** to measure tissue fluid pressure,
- an instrument to use alterations in the skull's acoustic properties to indirectly measure **intracranial pressure**,
- a **computer reader**, a **biofeedback system** and a **programmable remapper** (image processing and enhancement instrument) to improve reading skills in the visually impaired,
- a **UNISTIK** automobile driving facilitator which increases mobility of physically impaired drivers,
- a wearable **speech perception aid** for the hearing impaired, and
- a **Self-Injurious Behavior Inhibiting System (SIBIS)** which helps retarded and autistic patients refrain from self-injurious behaviors.

Some Recent Scientific Highlights of NASA's Orbital Research Program

- NASA researchers in collaboration with investigators at Genentech have shown that exercise coupled with doses of growth hormones that by themselves had no effect, can completely prevent muscle atrophy. This approach opens up a new therapeutic avenue for rehabilitation as well as for preventing some of the effects of aging.
- NASA research on the balance system has overturned a 50-year-old concept of gravity sensor organization. This work may lead to a deeper understanding of balance disorders and motion sickness
- NASA research has resulted in new discoveries on the organization of sensory neurons and the nervous systems capacity to adapt, and to heal after injury.
- Protein crystals have already been grown on the Space Shuttle for research into cancer, diabetes, emphysema, parasitic infections, and immune system disorders that are far superior to any crystals grown on Earth.
- The structural biology research group at Marshall Space Flight Center, recently published the first structure of a human antibody that recognizes the AIDS virus.
- A wide range of cell types have been successfully cultivated by academic and medical investigators using NASA technology.
 - Among these are:
 - First Norwalk virus culture grown outside the body
 - First 80-day lung culture
 - First normal human intestine culture
 - normal and cancerous ovarianprostatebladderbreast,and bone tissues

- Dr. Josh Zimmerberg of the NIH National Institute for Child Health and Human Development will employ NASA-funded bioreactors and NASA-funded resident technical staff to pursue AIDS research goals.
- Experiments on a 1995 Spacelab flight used a physical model of the atmosphere to provided unexpected evidence of fluid instabilities previously unpredicted by existing atmospheric computer models. Follow-on experiments will be carried out as part of the USML-2 mission this fall.
- Spacelab research has identified the existence of previously unknown regulatory processes that control blood and other fluids within our bodies.
- Spacelab research has indicated that the imbalance present on Earth between blood flow to the highest and lowest lung segments persists in space.

Appendix IV-C

Galley Proof of LBSAD Publication "Life Sciences Accomplishments '94".
The CSU team played a significant role in developing and editing Section 3.

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 - Musculoskeletal Physiology
 - Cardiopulmonary Physiology*
- Radiation Health
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PARTNERS IN SPACE

NASA/National Institutes of Health

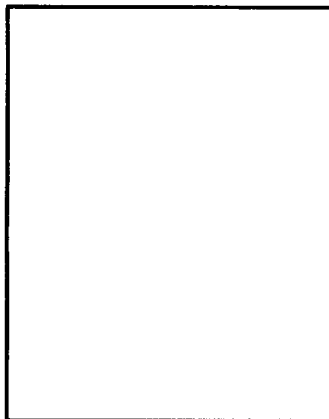
Telemedicine Demonstration Project—Spacebridge to Moscow

International Space Life Sciences Strategic Planning Working Group

"To myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

Sir Isaac Newton

This document is respectfully dedicated to the memory of



Rodney Ballard
(1942—1993)

whose commitment to excellence in the space life sciences and leadership in furthering international cooperation continues to guide our efforts.

FOREWORD

The year 1993 was dynamic and productive for NASA space life sciences. We progressed significantly toward our goals of understanding the role of gravity in living systems and using the resulting knowledge to improve the health and quality of life of people on Earth. Life sciences research encompassed the gravitational range from the microgravity of space to the hypergravity provided by centrifuge facilities on the ground. It included exciting advances in our knowledge of space and an improved program of supporting ground-based research. The Spacelab Life Sciences 2 flight set records both in duration and in the quantity and quality of science accomplished. The Cosmos 2229 mission in January, which carried U.S. experiments on the Russian biosatellite (Bion 10), and our participation on the German-sponsored Spacelab Deutsche 2 Shuttle mission in April were scientifically successful and serve as building blocks for expanding international cooperation in space life sciences research.

The formation of the Office of Life and Microgravity Sciences and Applications early in the year — with a life scientist at the helm — reemphasized the importance of life sciences in the space program. As an integral member of this new organization, the Life and Biomedical Sciences and Applications Division implemented new policies that have strengthened ground- and flight-based research, cooperative science activities with NASA's international partners, and the agency's ties with the National Institutes of Health (NIH).

Our division has initiated an annual divisionwide NASA Research Announcement and restructured the peer review

process to raise the scientific standards through greater competition and to provide more efficient, uniform, and systematic proposal evaluation.

In 1993, we were pleased to award two new NASA Specialized Centers of Research and Training (NSCORTs) to complement our overall ground-based program: one to the University of Texas Southwestern Medical Center for "Integrated Physiology" and the other to Northwestern University Medical School for "Vestibular Research." These awards brought the total number of NSCORTs addressing critical ground-based questions to seven, including a non-NASA Specialized Center on Radiation (in Germany).

Looking to the future, the excitement of discovery will continue with life sciences experiments on the upcoming International Microgravity Laboratory 2 mission, two additional Russian missions (Bion11 and 12), a joint program with Russia on Mir space station, and the Neurolab Spacelab mission to study the effects of microgravity on the nervous system and behavior. In 1994, we will expand our NSCORT Program by creating a joint center with the National Science Foundation to focus on plant physiology. We will continue to develop and use multiple research platforms in orbit, specialized ground-based facilities, collaborative approaches to ensure high-quality space life sciences research, new educational and outreach activities, and means to transfer life sciences technology to the private/commercial sector.

This Accomplishments Document is our Division's annual report to our investors, the American people. It describes how space life sciences research lays the foundation for enabling further human exploration of space

and improving U.S. competitiveness,
education, and quality of life.

page 3



Joan Vernikos, Ph.D., Director
Life and Biomedical Sciences and
Applications Division

INTRODUCTION

The NASA Life and Biomedical Sciences and Applications Division (LBSAD) serves the Nation's life sciences community by managing all aspects of U.S. space-related life sciences research and technology development. The activities of the Division are integral components of the Nation's overall biological sciences and biomedical research efforts. However, NASA's life sciences activities are unique, in that space flight affords the opportunity to study and characterize basic biological mechanisms in ways not possible on Earth. By utilizing access to space as a research tool, NASA advances fundamental knowledge of the way in which weightlessness, radiation, and other aspects of the space-flight environment interact with biological processes. This knowledge is applied to procedures and technologies that enable humans to live and work in and explore space and contributes to the health and well-being of people on Earth.

The activities of the Division are guided by the following three goals:

- Goal 1** Use microgravity and other unique aspects of the space environment to enhance our understanding of fundamental biological processes.
- Goal 2** Develop the scientific and technological foundations for supporting exploration by enabling productive human presence in space for extended periods.
- Goal 3** Apply our unique mission personnel, facilities, and technol-

ogy to improve education, the quality of life on Earth, and U.S. competitiveness.

The Division pursues these goals with integrated ground and flight programs involving the participation of NASA field centers, industry, and universities, as well as interactions with other national agencies and NASA's international partners. The published work of Division-sponsored researchers is a record of completed research in pursuit of these goals, as reflected in the following table.

LBSAD and Exobiology Publications

Published by	Total	Journal articles	Meeting abstracts/papers	NASA formal papers	Other
1992					
LBSAD	1073	533	462	67	11
Exobiology	319	173	113	14	19
Total	1392	706	575	81	30
1993					
LBSAD	905	452	382	64	7
Exobiology	204	180	13	3	8
Total	1109	632	395	67	15

During 1993, the LBSAD instituted significant changes in its experiment solicitation and peer review processes. For the first time, a NASA Research Announcement (NRA) was released requesting proposals for ground-based and flight research for all programs. Areas of particular interest to NASA were defined. Proposals due April 29, 1994, will be peer reviewed externally for scientific merit. This annual NRA process is now the mechanism for recruiting both extramural and intramural investigations.

As an overview of LBSAD activities in 1993, this accomplishments document covers each of the major organizational components of the Division and the accomplishments of each. The second section is a review of the Space Life Sciences Research programs — Space Biology, Space Physiology and

Countermeasures, Radiation Health, Environmental Health, Space Human Factors, Advanced Life Support, and Global Monitoring and Disease Prediction. The third section, Research in Space Flight, describes the substantial contributions of the Spacelab Life Sciences 2 (SLS-2) mission to life sciences research and the significant contributions of the other missions flown in 1993, along with plans for future missions. The Division has greatly expanded and given high priority to its Education and Outreach Programs, which are presented in the fourth section. The fifth and final section, Partners for Space, shows the Division's cooperative efforts with other national and international agencies to achieve common goals, along with the accomplishments of joint research and analysis programs.

OUTREACH

The Division is accountable to the American public for its investment in the Nation's space program. LBSAD outreach activities are a part of this accountability process. Outreach efforts involve the education of, and dissemination of information to, the scientific community, students, and the general public about NASA space life sciences activities and programs. This enables them to understand how space life sciences research benefits not only the Nation but individuals as well. Examples of outreach activities in 1993 include, but are certainly not limited to, peer reviews of publications, scientific symposia and workshops, television and radio programs, exhibits and displays, classroom lectures and presentations at scientific meetings, informational brochures and flyers, and the publication of multiple volume books. Special attention is given to formal and informal education and training programs for students with emphasis on attracting women and minorities to careers in space life sciences.

LBSAD Newsletter and Public Relations Materials

The *NASA Space Life Sciences Newsletter* was started in 1992 to provide information about LBSAD activities, accomplishments, and challenges to NASA personnel, the space life sciences community, and the general public. The newsletter has a current distribution list of more than 1100 throughout the United States and foreign countries. Any individual or organization may subscribe to the newsletter free of charge.

Throughout 1993, LBSAD continued to publish the newsletter with issues for Winter

1993, Summer 1993, and Fall 1993. Articles, such as "Cooperative Activities with NASA's International Partners Leading to New Era in the Space Life Sciences," "Space Life Sciences Help to Advance Science and Technology on Earth," and "Trio of Spacelab Missions Probes Role of Gravity in Living Systems," provide the latest information on the topics that are most pertinent to the space life sciences community.

Brochures and information sheets on life sciences programs were prepared and distributed to interested citizens. Topics include NASA Life Sciences Research and Women's Health; U.S./Russian Cooperation in the Space Life Sciences; Telemedicine, Telemedicine in the United States, and Spacebridge to Moscow; Acquiring New Insights into the Processes of Life; The U.S. Civil Space Program; Science and Human Health; NASA's Environmental Health Program; and the SLS-2 and IML-2 missions. Also included in the 1993 public information packet is a full-color lithograph of SLS-2, with a description of the nature and benefits of SLS-2 research on the reverse side.

Presentation at the United Nations

In 1993, a representative of the LBSAD Human Factors Program gave an invited address entitled "The NASA Space Human Factors Program—Putting Humans in Space, Helping People on Earth." In the speech, which was given to the United Nations Committee on the Peaceful Uses of Outer Space, the representative described the work the program is currently supporting and illustrated its important implications for human activity and quality of life.

Workshop on Research in the Microgravity Environment Related to Cardiovascular, Pulmonary, and Blood Functions and Diseases

According to participants, workshops are the most productive way for NASA life sciences researchers to interact with their colleagues in academia and other government, medical, industrial, and nonprofit institutions. At LBSAD-sponsored workshops, NASA scientists communicate their interests, problems, and insights and describe available research opportunities to colleagues, who, in turn, provide valuable insights and solutions from their own perspective or are motivated to embark on an area of research potentially useful to NASA. One such recent workshop was sponsored jointly with the National Heart, Lung, and Blood Institute (NHLBI) of the NIH. Its purposes were to share current knowledge of the effects of microgravity or altered gravitational conditions on cellular and physiological functions; to discuss how this knowledge might elucidate basic mechanisms and disease processes on Earth; and to recommend further research activities on Earth and in the space environment related to cardiovascular, lung, and blood diseases. Conclusions and recommendations generated by this workshop will be made public in 1994.

Publication of Book Jointly With Russian Academy of Sciences

In 1975, NASA and the U.S.S.R. simultaneously published English and Russian editions of a three-volume work entitled "Foundations of Space Biology and Medicine," containing chapters written by leading U.S. and Soviet experts. This classic work comprised an exhaustive review of funda-

mental and applied areas in space medicine, biology, and related fields covering expertise acquired by the scientists of both countries over the first 15 years of space exploration. This edition became a unique source book, providing sound reference material for students and scientists. However, since the first edition was published, many advances have been made in space life sciences research and technology. Thus, another attempt to summarize and analyze knowledge in this area has been initiated. The new five-volume work is the result of the efforts of a joint editorial board presided over by U.S. and Russian editors. Chapter authors from one or more of the participating nations are the leading specialists in their areas.

In 1993, after a number of years of work on both sides of the Atlantic, the English version of Volume I of the joint treatise was published. This volume, entitled "Space and Its Exploration," set the stage for the material to follow by describing the historical context and physical environment of space flights, as well as discussing various aspects of the general issue of life in the Universe.

Also, during 1993, scientific and editorial work was completed on the English version of Volume II. Entitled "Life Support and Habitability," it provides comprehensive treatment of the spacecraft environment and the technological and biological systems that have been developed to meet human needs in this unique setting.

Subsequent volumes of this work will be concerned with the effects of space-flight factors on humans and other living organisms and issues associated with the operational support of space flights. The last volume will include extensive reference material relevant to the major topics discussed in the previous volumes.

Education and Training Programs

LBSAD's educational activities were productive in 1993. The Space Life Sciences Training Program (SLSTP) concluded its ninth year of operation and now has more than 300 alumni; the NSCORT Program expanded to include a new Center for Vestibular Research supported jointly by NASA and the NIH NIDCD; and a new program to sponsor research in space physiology, the Graduate Students Research Program, was started. In addition, a concerted effort was made to focus, integrate, and expand Division programs. A Director for Education and Outreach was appointed, and a strategic planning process was initiated.

In 1993, LBSAD involved hundreds of students and teachers in a spectrum of programs that exposed them to a range of life sciences activities. For some of these students and teachers, this interest may lead to career paths more directly related to the life sciences and engineering; for the vast majority, it will contribute to the understanding of science that is required for civic and economic well-being in a technological society. Some of highlights from 1993 are provided in the following sections.

Space Life Sciences Training Program

The SLSTP is an intensive 6-week summer program at KSC, which utilizes lectures, tours, special projects, and research experience with NASA scientists to teach approximately 40 undergraduate trainees about requirements for life sciences research in space. In 1993, this program successfully completed its ninth year of student training. Jointly sponsored by the Office of Equal

Opportunity Programs and the LBSAD at NASA Headquarters, the program has been successful in recruiting and training women (54 percent) and underrepresented minorities (20 percent Black, 10 percent Asian, 1 percent Pacific Islander, and 2 percent Native Americans).

Space Physiology Graduate Student Research Grants

This new program was established in 1993. The program is open to Ph.D. candidates who are national members of the American College of Sports Medicine and are pursuing research relevant to gravitational physiology and the effects of exercise.

NASA Specialized Centers of Research and Training

NSCORT grants provide graduate and postgraduate training by involving students in ongoing research activities. In addition to practical laboratory training, special courses have also been developed. Outreach activities have also been directed toward undergraduate students. As a result of the NSCORT for Vestibular Research established in 1993 at Northwestern University Medical School, which is jointly funded by NASA and NIDCD, the number of students studying balance disorders in the United States increased by 50 percent.

Aerospace Medicine Residency Training Program

This 2-year program conducted at Wright State University School of Medicine, Dayton, Ohio, confers a Master of Science degree in aerospace medicine and prepares physicians for board certification in aerospace medicine. The program provides clinical aerospace training for medical doctors and a third-year

rotation at a NASA center. Sixty-four (38 U.S. and 26 international) students have been graduated since 1981.

Space Biology Research Associate Program

This program provides postdoctoral fellowships to conduct research on gravitational and space biology at university laboratories. Fellowships, which are renewable annually, are granted on the basis of competitive, original research proposals. To date, 75 host laboratories have participated in the program, graduating 59 fellows.

Graduate Student Research Program (GSRP)

The GSRP provides a 1-year fellowship (renewable for up to 3 years) for graduate students conducting research relevant to space life sciences. Opportunities exist for students to work in residence at NASA field centers.

Human Physiology in Space

This high school curriculum supplement uses the excitement of space to teach students about physiology. The curriculum supplement consists of student and teacher manuals, slides, and other teaching materials. In 1993, the process of updating the content of the curriculum was begun.

National Research Council Resident Research Associateship

This program provides postdoctoral fellowships at NASA field centers. Twenty-six fellows began their research with NASA in 1993.

Video Teleconferences for Secondary School Teachers

The LBSAD participates in the NASA Education Update for Teachers Videoconference series. The annual series consists of sets of four lectures used in staff development programs for elementary and secondary school faculty. Approximately 2500 teachers viewed these video teleconferences in 1993.

Spacelab Embryology Display and Lesson Plan

Based on the intense interest in the Frog Embryology experiment flown on Spacelab-J in 1992, NASA developed a space science lesson plan, classroom materials, and a videotape for school children in grades 3 through 6. A portable display and supplementary handout materials were developed for use at public events.

Informal Educational Activities

In 1993, LBSAD participated in a number of informal educational activities, including presentations to primary and secondary school classes; sponsorships of high school and undergraduate interns; and work with other agencies, such as the Smithsonian Institution's National Air and Space Museum.

Technology Transfer: Disinfecting Recycled Water

Life sciences personnel at JSC helped to develop a potable water treatment device, which received the NASA 1993 Invention of the Year award in both the commercial potential and NASA benefit categories. The device was originally developed so that astronauts on long space missions could

safely recycle their water for drinking. Iodine has long been used to disinfect water, including the water on the Apollo missions, but this device is the first to send the water through a resin bed that is automatically replenished with iodine when the levels get too low.

The device is an attractive alternative to chlorination and other conventional water treatment technologies, because it does not use hazardous gases and cannot overtreat the water. The commercial potential is great, particularly in developing nations, where the need to maintain a safe water supply is critical.

Appendix V

Report to NASA Space Life Sciences Managers Concerning the Important Education and Outreach Concepts Contained in a NASA News Conference Announcing the Results of a Biannual Assessment of NASA Outreach Programs.

10/21/94
Linda Billings for Code UL

Highlights from
"The Information Needs of the Public Concerning Space Exploration:
A Special Report to the National Aeronautics and Space Administration"
by Jon D. Miller, Vice President, Chicago Academy of Sciences
June 1, 1994

- Miller updates this study for NASA HQ/Code P every two years.
- "The long-term baseline of high interest in space exploration includes about a quarter of American adults."
- The attentive public for space exploration (those who consider themselves interested and informed) declined from 8 percent in 1990 to 6 percent (11 million people) in 1992.
- This attentive group is predominantly male, high school educated, and married. It includes twice as many men as women.
- For the first time since Miller started doing these studies for NASA in 1979, the percentage of young people (under 25 years) attentive to space exploration dropped below 10 percent -- *down to 3 percent.*
- "...The emergence of new sets of political issues with special relevance to young adults and to women may have led some individuals to become less interested in space exploration...."
- "Support for the space station declined markedly among those citizens with lower levels of interest in space exploration."
- "The proportion of attentives favoring cuts in space spending increased in 1990 and 1992."
- "Even among those citizens with a high level of interest in space exploration and who believe themselves to be well informed, there are vast areas of ignorance and misunderstanding."
- "Using Miller's measure of scientific literacy, it appears that 15 percent of the attentive public for space policy qualified as scientifically literate in 1992. Only seven percent of all American adults qualified as scientifically literate on this measure.... This result raises serious questions about the ability of even the attentive public to handle sophisticated explanations of the objectives and missions of the space program."

Re: committing to improve scientific literacy --

- "Without an improved level of scientific literacy in the United States, NASA will face increasingly difficult problems in the decades ahead in

communicating to the public about its programs and, eventually, in maintaining a high level of public support."

- "If we are to stop the flow of scientific illiterates from high school into the electorate and the work force, however, it is imperative for NASA to expand and improve its efforts to upgrade science and mathematics education in the United States from elementary school through graduate school."
- "In thinking about messages for students, it will be important to link the space program to new scientific and engineering advances and to the flow of these ideas into products and services that benefit a wide range of individuals."
- "At the adult level...it is important to foster both an appreciation for the science and technology utilized in space exploration, and a clear understanding of the basic scientific concepts underlying these technologies...."
- "NASA should focus a portion of its communication program on addressing the information needs of ...[the attentive] segment of the population without abandoning its general responsibilities to inform all Americans about the world of the space program.... It is necessary to think about simultaneous channels of communication to a wide range of audiences with a variety of information needs. It is a challenging task, but it is a necessary one."

Re: communications strategies --

- "As the implications of the end of the Cold War become more widely accepted and understood, it is important that the space program not be characterized as a dinosaur from the era of the Great Space Race with the Soviet Union."
- "It is necessary to develop programs to communicate basic scientific understanding as well as mission-related information."
- NASA should initiate "new efforts to communicate program-relevant information in terms understandable to [the attentive] group, but with additional scientific and technical information designed to improve their general scientific literacy."
- "It is important to begin to develop communication strategies to demonstrate the value of space activities to the advancement of science, environmental measurement and protection, and manufacturing and economic benefits.... Concerns about education and health care will remain at or near the top of the domestic agenda for at least the next decade...."
- "The attentive public for space policy can be reached through the use of newspapers, news magazines, science magazines, science television shows such as Nova, and through special television news shows such as Nightline. Citizens attentive to space policy issues are frequent visitors to science and technology museums and frequent users of their public libraries. The channels through which to communicate are available.... To be effective in these channels, it will be necessary to do more than the traditional...news releases, sound bites, film clips, news conferences, and live shots of launches and landings. Those things must continue...but they are not enough...."

Appendix VI

Final Report of the NASA Science Communications Strategy Produced by the
NASA Science Communications Working Group (SCWG).
Dr. Coulter was an member of the SCWG.

NASA

Science Communications Strategy

Final Report

of the

NASA Science Communications

Working Group

(SCWG)

June 15, 1995

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Executive Summary

Change is sweeping the landscape of federal science communications. The demand for information regarding the effective expenditure of taxpayer dollars continues to increase as available resources continue to decline. The responsibility to not only increase scientific knowledge, but to share it broadly with the American public has become one of the Administration's highest priorities. As such, an increased emphasis has been placed on proactive science information distribution by Federal agencies.

In 1994, the Administration issued a report, *Science in the National Interest*, which identified new national science goals. Two of the five goals are related to science communications:

- Produce the finest scientists and engineers for the 21st century
- Raise scientific and technological literacy of all Americans

In addition to the guidance and goals set forth by the Administration, NASA has been mandated by Congress under the 1958 Space Act to "provide for the widest practicable and appropriate dissemination concerning its activities and the results thereof."

The environment in which NASA conducts its communications activities is also undergoing change. As information demands grow among members of the science community, media and general public, so do the technologies for disseminating such information. Perceptions have evolved among some segments of the public that NASA is not meeting the information demands of its customer base. Although NASA's current science communications activities are aggressive and well diversified, the agency is challenged with improving its ability to meet increasing demands for information in an era of decreasing resources.

In addition to addressing eight Goals and Plans which resulted from a January, 1994 meeting between NASA and members of the broader scientific, education and communications community on the Public Communication of NASA's Science (Appendix D), the Science Communications Working Group (SCWG) took a comprehensive look at the way the Agency communicates its science to ensure that any changes the Agency made were long-term improvements. In all, 23 separate studies were conducted by the SCWG across a wide spectrum of NASA activities. The SCWG developed a Science Communications Strategy for NASA and a plan to implement the Strategy.

Appendix A

Science Communications Steering Committee and Working Group Membership:

Steering Committee Membership

France Cordova
Spence Armstrong
Laurie Boeder
Wesley Huntress
Harry Holloway, M.D.
Charles Kennel

Chair, NASA Chief Scientist
AA/Human Resources and Education
AA/Public Affairs
AA/Space Science
AA/Life and Microgravity Sciences
AA/Mission to Planet Earth

Working Group Membership:

Lyn Wigbels
Neal Newman
Pamela Mountjoy Bacon
Rick Smith
Paula Cleggett-Haleim
Terri Hudkins
Jens Feeley
Margo Bailey
Stephan Fogleman
Dan O'Connor
Mark Pine
Lisa Ostendorf

Chair
Executive Secretary
Human Resources & Education
Human Resources & Education
Public Affairs
Public Affairs
Space Science
Space Science
Life and Microgravity Sciences
Life and Microgravity Sciences
Mission to Planet Earth
Mission to Planet Earth

Working Group Advisors:

Julie Baker
Pam Werner

Office of the Comptroller
Office of the General Counsel

SCWG Findings

I. Introduction

The Government has made the communication of science information a high priority, an effort to which NASA brings unique information, programs, and capabilities. This national effort requires that NASA develop a strategy to coordinate its science communications efforts. The primary issue that must be addressed in this strategy is expanding access to NASA scientific results and information. NASA must recognize that attempting to do this will result in greater demand at a time when the agency is faced with reduced resources. Thus, NASA must continually seek the means to do more with less.

An effective NASA science communications strategy should encompass both centralized planning and coordination, coupled with decentralized custom tailoring to meet individual program and project needs. As such, NASA Centers should assume greater responsibility for implementation of science communications efforts. Further, an effective science communications strategy requires a continuing mechanism or process capable of developing broad plans and policies for NASA science communications. Upfront and continuing coordination is required across Codes and Centers on all NASA science communications products and activities.

This report outlines a Science Communications Strategy from which effective science communications programs can be developed and implemented across the agency. Guiding Principles and Strategic Themes for the Strategy are provided, with numerous recommendations for improvement discussed within the respective Themes.

II. SCWG Vision, Mission Statement

The SCWG developed the following science communications Vision and Mission Statement for the NASA Science Communications Strategy.

The Agency's commitment to long-term reform is demonstrated by the adoption of a new goal in the NASA Strategic Plan which specifies the importance of science communication. To provide continued coordination across NASA offices, a communications roundtable will be established and chaired by the Office of Public Affairs. NASA's Science Council will assess the effectiveness of the roundtable and review the Science Communications Strategy on an annual basis.

As a result of a full year of studies and analysis, the SCWG finds that NASA has the opportunity to become a national leader for new standards in communicating science to the public. Because of its unique agency role, NASA can provide leadership and assistance in the definition of appropriate government roles in science communication. By shifting its communications emphasis from the "what" to the "why," by focusing on upfront coordination in the development and use of communications products and services, and through more effective and efficient use of NASA's as well as others resources (financial, technological and expertise), NASA can become a national model for the effective communication of valuable and informative science.

SCWG Vision Statement:

NASA contributes to America's future by communicating unique scientific information. This endeavor increases the public's knowledge, understanding and application of science and technology which inspires and serves America and benefits the quality of life on Earth.

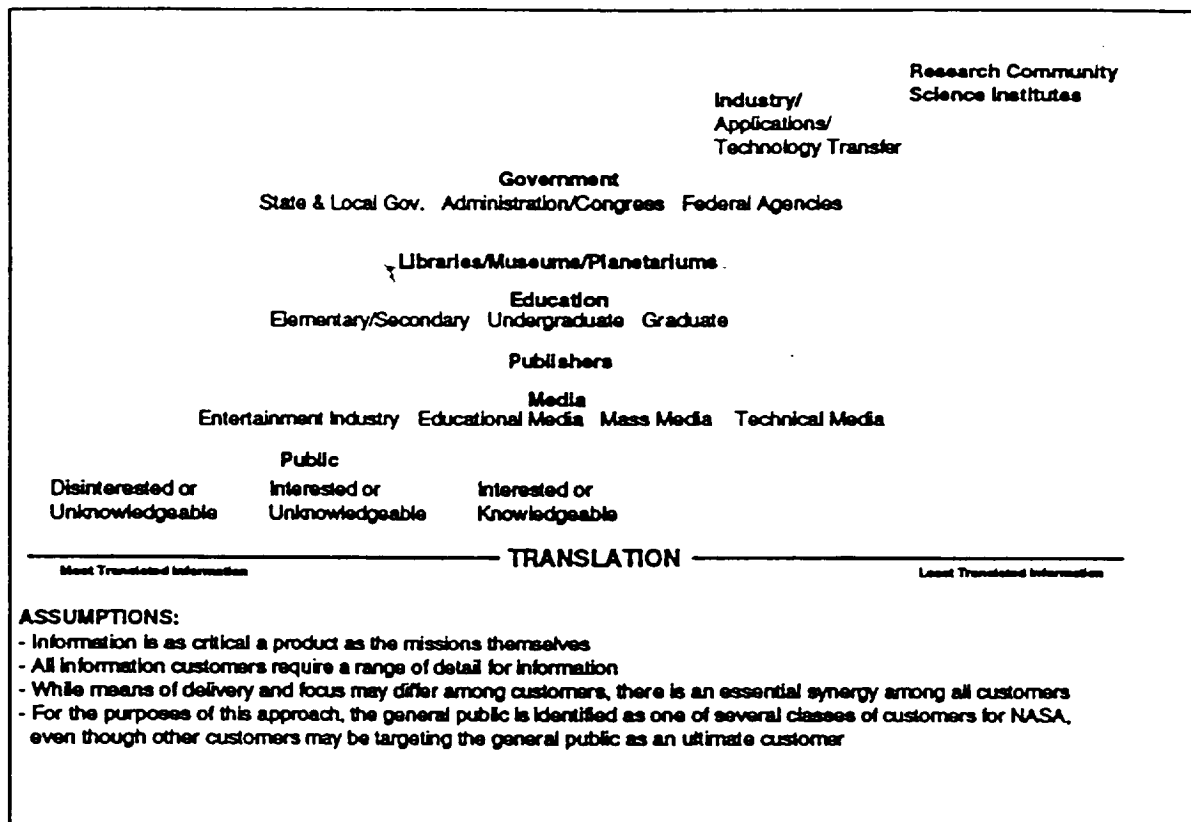
SCWG Mission Statement:

Our challenge is to use NASA's resources to best communicate the excitement of our missions and discoveries to our diverse customer community in a way that is understandable, promotes scientific literacy, and demonstrates application to their lives.

- We involve the educational community in our endeavors to inspire America's students and create learning opportunities, and enlighten inquisitive minds of all ages.
- We provide the widest practicable and appropriate dissemination of information to the news media and general public concerning the objectives, methods and results of NASA programs.
- We work closely with the research community to provide ready access to data and analysis and we assist them in clearly communicating these results and their significance to the broader public.
- We join with our industrial partners to facilitate the commercial development and innovative application of NASA-developed technologies to the benefit of all Americans.
- We cooperate with external groups to leverage their unique skills, expertise and resources to significantly assist in the interpretation and dissemination of information.

Further, as a result of a SCWG recommendation, science communications has been incorporated into the NASA Strategic Plan as an Agency goal.

The SCWG chose to depict its science information customers along a continuum which is defined by the amount of translation required to successfully convey the information (Chart 1). While the means of delivery and focus may differ among customers, the SCWG found that an essential synergy existed among all customers.

Chart 1: NASA's Continuum of Customers for Science Information

III. Guiding Principles

To maximize the effectiveness of its efforts, NASA's science communications strategy should be guided by certain basic principles. In summary, NASA must demonstrate its relevance, focus its messages, identify its unique contributions, incorporate technology, emphasize diversity, and explore how its efforts could flexibly serve multiple audiences.

Relevance

NASA's science communications efforts should clearly establish why science results and investigations are important and of benefit to society. This principle entails a shift in communications emphasis from the "what" to the "why."

Focus

As the quantity and quality of information available to the public increases, NASA must focus its science communications to clearly convey its results and message in a manner consistent with changing national standards and priorities.

Uniqueness

NASA's efforts in science communications should center on those activities and products to which it can most effectively bring to bear its unique capabilities and resources.

Technology

To the extent possible and appropriate, technological innovation and advances should be incorporated into our science communications efforts. This will not only extend the reach of these efforts, but will also increase the range of services NASA is able to offer. However, NASA must be mindful that a "two-track" communications approach will be required for several years in order to meet the needs of both high and low-tech audiences.

Diversity

Our efforts should seek to include all segments and areas of society, both through program message and execution.

Flexibility

NASA communicates science to a broad continuum of customers and must consider how approaches could synergistically serve multiple audiences.

IV. Strategic Themes

The SCWG recommended that a Science Communications strategy encompasses the following themes: leadership, coordination, integration, participation, leveraging, and evaluation. Each Theme is discussed in some detail below. Specific recommendations of the SCWG are summarized under each of the Themes. An Implementation Plan, which lists the respective actions and office of responsibility for each of the recommendations is attached as Appendix C.

Theme 1 **LEADERSHIP**

NASA must provide interagency leadership and assistance in the definition of an appropriate federal government role for Science Communications.

Communicational at every opportunity

Recommendation: Provide Leadership/Assistance in the Definition of an Appropriate Federal Role

To this end, NASA's Chief Scientist has been designated as chair of the National Science and Technology Committee's Subcommittee on Communicating Science to the Public. This subcommittee has already begun working to:

- define appropriate Federal role
- define appropriate level of interagency resources (personnel, and funding), relative to other agency priorities, to effectively communicate science
- explore partnering arrangements with federal and non-federal participants

Recommendation: Definition of NASA's Role

In addition to providing leadership and assistance at the federal level, NASA must also define its unique role in the communication of its science. NASA should undertake this effort once the appropriate Federal role has been defined.

Theme 2 **COORDINATION**

NASA's science communications efforts must be fully coordinated to focus a broad range of views and capabilities to most effectively communicate science to the public, and to extend limited resources.

Excellent need to continue this

Recommendation: Integrated Communications Teams

...as an outcome to success in coordinated approach

One of the major findings which was validated through several of the SCWG studies was the need for upfront coordination in the development and use of communications products and services. Upon reviewing the common characteristics of several successful science communications activities (Hubble Space Telescope First Servicing Mission and Compton Gamma Ray Observatory are but two examples), the SCWG discovered that by convening teams of experts from different functional areas, a high level of coordination is

achieved. Thus, the SCWG recommends the establishment of Integrated Communications Teams (ICT's). Associate Administrators or their designees should be responsible for managing, in coordination with appropriate offices, science communications activities for major science themes as they relate to major missions and programs. The ICT's should be composed of program, project, public affairs and education representatives. It is important that the ICT approach be implemented early on in the life of a mission, and that it be continued for the life of the science communications effort.

Status

Recommendation: Communications Roundtable

As a means of ensuring that NASA communications across the board are well coordinated, a NASA Communications Roundtable should be established and chaired by the Office of Public Affairs. The Roundtable should be comprised of working-level representatives appointed by each Associate Administrator. Participation should include all program and staff offices with substantial involvement in NASA communications. The Roundtable should meet on a quarterly basis for approximately two hours to discuss current coordination, agency policy direction, and outstanding issues. Electronic mail would be the primary means of communications between meetings. An assessment of the Roundtable's effectiveness should be conducted by the NASA Science Council in one year.

Review Process

Recommendation: NASA Exhibits Program

The Office of Public Affairs, the Science Codes and NASA Centers should review NASA's inventory of exhibits that feature science subjects, assess their responsiveness to the new national science goals of communicating science to the public, and use this as a foundation when developing new exhibits.

Before an exhibit is initiated, the NASA Headquarters science Codes and /or Center project offices should coordinate with the Office of Public Affairs to consider: message (responsiveness to new national science goals), audience, budget, duplication, and long-term usefulness. Also, the use of interactive multi-media should be considered when designing exhibits.

ICT

Finally, the Office of Public Affairs should initiate a study of creating on-line exhibits.

Other COORDINATION Recommendations:

- Efforts should be made to standardize certain communications product development and service processes with an aim towards providing better products and services and eliminating duplication and overlap. This recommendation is targeted to any NASA program or staff office responsible for the development of science related publications or exhibits, or which is responsible for responding to science related public inquiries.
- NASA should create a mechanism to consolidate message development across the agency. This would alleviate some of the variances in responses coming from different parts of NASA.
- The science program offices should work with Codes AIC, F, L and P to prepare draft responses to frequently asked questions, reducing the time required to address certain inquiries.

Theme 3 **INTEGRATION**

Science communications must be embedded in everything that NASA does, as an essential component of the agency's mission.

Recommendation: **Modify the NASA Strategic Plan**

NASA's Mission Statement should be modified to reflect the importance to the agency of science communications. The SCWG has developed proposed changes to the NASA Mission Statement which, if adopted, would add a fourth mission that reflects the importance the agency places in the communication of its science. The proposed changes are indicated by underlined text below.

Proposed NASA Mission Statement:

It is NASA's mission to:

- Explore, use, and enable the development of space for human
- Advance scientific knowledge and understanding of the Earth, the Solar System, and Universe and use the environment of space for research
- Research, develop, verify, and transfer advanced aeronautics, space, and related
- **Communicate our unique scientific information to increase the public's knowledge, understanding and application of science and technology.**

The SCWG recommends that the science Codes and Codes P and F pursue the above Mission Statement modifications during the next formal Strategic Plan review cycle.

Recommendation: Communications Strategies for Major Science Themes

The SCWG recommends that science communications strategies be developed early on in the lifetime of science themes as they relate to missions and programs. These strategies should be coordinated with Public Affairs and Human Resources and Education, and they should be part of a checklist of requirements for New Starts. A summary of the strategies should also be incorporated into Program Commitment Agreements. Finally, existing NASA Management Instructions should be revised to reflect these requirements.

Recommendation: Integrate Strategies into Strategic, Program and Project Plans

The SCWG recommends that plans and strategies for communicating science to the public be mandatory elements of strategic, program and project plans. Public Affairs and Education representatives should be included in the development of these plans.

Science communications strategies should be reviewed at non-advocate and other mandatory Program and Project reviews.

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It is NASA's mission to:

- Explore, use, and enable the development of space for human
- Advance scientific knowledge and understanding of the Earth, the Solar System, and Universe and use the environment of space for research
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- **Communicate our unique scientific information to increase the public's knowledge, understanding and application of science and technology.**

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Science communications strategies should be reviewed at non-advocate and other mandatory Program and Project reviews.

Recommendation: Integration of Emerging Technologies

Automated and electronic distribution of materials is fast becoming the most efficient means to reach large numbers of people. NASA needs to explore how it could better integrate emerging technologies into its dissemination of scientific information and materials. It appears that these emerging technologies offer substantial cost/benefit ratios over the long run, while providing reliable and timely dissemination of information. Specifically:

- NASA should establish a coordination policy, including roles, responsibilities and format for the electronic dissemination of scientific information.
- NASA should conduct a one-year pilot program using emerging technology to enable members of the public without modern communications equipment toll-free access to NASA information.
- NASA should perform a cost/benefit analysis of providing electronic instead of hardcopy publications. Such a capacity would transition the NASA publications facility into a virtual warehouse which could provide electronic access and print on demand.
- A feasibility study should be conducted into the development of automated systems that help customers rapidly locate relevant NASA information and tools, without having to know where the resources are located. Such a system could be located on the NASA home page.
- When developing publications, the NASA science program offices should "build into" their publications the capacity for electronic distribution of information.
- NASA should conduct a feasibility study on the establishment of a national "Post Haste" -style interactive information system, accessible through a toll free 1-800 number.
- NASA should explore enlarging the number of educators having access to toll free 1-800 service offered by Spacelink/Quest.
- NASA should expand the use of automated list servers to effectively and efficiently disseminate science information.
- NASA should develop a 1-page document that captures the basics about how to get information from NASA (phone numbers, TRC's CORE, etc.). This would be an especially useful tool for NASA speakers.

Other INTEGRATION Recommendations:

- Continuity of message/materials must be provided across all agency science communications functions (education, legislative, public affairs, public mail, etc.)
- All science communications efforts should include or support Administration, NASA, enterprise, programmatic/thematic, local objectives (in order of priority).

Theme 4 **PARTICIPATION**

Full participation by every member of the NASA team is essential if NASA is to meet its potential in communicating its results. Science communications should be established as a legitimate and achievable responsibility to be supported by every NASA employee and by every scientist that is conducting NASA research.

Recommendation: **Announcement of Opportunity Outreach “Tools”**

In *Science in the National Interest*, the Administration calls for Federal Agencies to encourage research scientists to use their research experience in support of public understanding and appreciation of science.

The science community should be required or encouraged to take a more active role in communicating their results to the broader public. To strengthen the translation of scientific research into science communications, the SCWG developed the following flexible set of “tools” to use in its research solicitations:

- a. Requiring that science communications plans in appropriate NASA science activities be submitted and evaluated as an evaluation criteria in the awarding process.
- b. Issuing supplemental or separate educational grants.
- c. Encouraging research proposers to become more active in science communications.

Several recent research solicitations have incorporated these tools. The Discovery program Announcement of Opportunity is a notable example, in which NASA has called for a science communications plan as part of the proposal requirements.

Recommendation: NASA Speakers Bureau

NASA has established a unified, agency-wide Speaker's Bureau, complete with a data base, which allows better matching of speakers to the speaking engagement. A variety of tools are under development to enhance the speaker's ability to communicate.

The SCWG finds that senior NASA management needs to openly validate the role of NASA employees in participating in the Speaker's Bureau and provide recognition and support to those employees that do participate in the program. To this end, the Office of Public Affairs should draft a memo from the NASA Administrator to officials in charge encouraging support for NASA employee participation in the Speaker's Bureau.

Science Codes should provide support to Public Affairs for the development and implementation of a proactive speaker's strategy to communicate science to the public effectively.

Recommendation: Recognizing Excellence in Science Communication

Per a recommendation by the SCWG, NASA has revised the language used in its annual call for awards to emphasize that non-NASA individuals should be considered for NASA awards for recognition of achievements in communication of science to the public. NASA employees have been encouraged to consider the nomination of such non-NASA individuals. Such encouragement should be continued.

Recommendation: Astronaut Appearance Program

The Astronaut Appearance Program has often been referred to as one of NASA's most effective resource in making the public aware of the agency's policies, programs and achievements.

The Office of Public Affairs, the Office of Space Flight and the Johnson Space Center's Astronaut Office should review their joint policies, practices and strategies for accepting and declining astronaut appearance requests to ensure they share the same priorities. Such a review should include an attempt to coordinate astronaut appearances with other NASA science communications efforts, such as exhibits, to further communicate NASA's science messages. Further, the review should identify budget and target opportunities for astronauts to communicate science to the public with a focus on groups not traditionally reached.

Other PARTICIPATION Recommendations:

- The Chief Scientist, working with the science offices, Public Affairs and Human Resources and Education should develop a science communications message for the Administrator to present to NASA employees. This message should stress the responsibility of each NASA employee to support science communications efforts. The Office of Mission to Planet Earth has agreed to lead this effort.
- NASA's science offices should explore the use of IPA's and cooperative agreements to bring in outside expertise and to provide assistance in NASA's science communications efforts
- The Office of Human Resources and Education should develop a training plan for the science community and others to improve their ability to convey NASA's science results in the best way possible.

Theme 5 LEVERAGING

Whether through funding or partnership, NASA must work more extensively with its intermediaries and customers to more efficiently and effectively convey science results. To do this, NASA should pursue relationships with non-NASA individuals, agencies and organizations who have the expertise and resources to extend NASA's ability to more effectively communicate science. A successful leveraging effort is essential if the agency is to make its scientific discoveries available to a broader audience while extending its limited resources.

Recommendation: **Identify Leveraging Opportunities and Undertake New Pilot Leveraging Efforts**

Over the next year, NASA should work to identify a broad range of potential new partners and undertake new pilot leveraging efforts. In doing so, NASA should seek leveraging arrangements in which the agency plays a specific, defined role and for which there is a finite aspect to our participation. NASA should also explore a wide range of financial arrangements, and should not automatically exclude those which require the expenditure of its resources.

Recommendation: **Improve Access to NASA Information**

NASA should improve its intermediaries' and customers' access to NASA information (See recommendations under Integration of Emerging Technologies)

Theme 6 **EVALUATION**

Metrics for performance and continual assessment of effectiveness should be a fundamental element of all science communications efforts, followed by any necessary adjustments.

Recommendation: **Annual Review of Science Communications Strategy**

The NASA Science Council should review the Science Communications Strategy on an annual basis. Science Communications Performance Goals, which have been developed by the SCWG (Appendix B), should be used to conduct this evaluation, along with specific metrics provided by each of NASA's science offices, Public Affairs and Human Resources and Education.

Other EVALUATION Recommendations:

- NASA should seek regular customer input and evaluation of programs, as well as advice from existing agency advisory committees.
- When appropriate, non-FACA advisory groups such as Focus Groups and Round Tables should be implemented to obtain independent perspectives on how well NASA communicates science. This approach offers:
 - flexibility
 - immediate initiation of process
 - instantaneous feedback
 - easy adjustments of memberships
 - greater potential for media professional participation

Appendix B

NASA SCIENCE COMMUNICATIONS STRATEGY PERFORMANCE GOALS

OUTCOME:

We involve the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds. In doing so, NASA seeks to promote excellence in America's education system through enhancing and expanding scientific and technological competence.

OUTPUTS:

1. NASA student programs provide exposure to the NASA mission, participation in research and/or training experiences in science, mathematics, engineering, and technology and other related disciplines.
2. NASA opportunities for teachers/faculty provide information, techniques and experiences emphasizing discipline, content and depth related to teacher/facility teaching levels and subject areas.
3. NASA instructional products target customer needs, support the national education standards, and utilize educational technologies when appropriate.

OUTCOME:

We provide the widest practicable and appropriate dissemination of information to the news media and general public concerning the objectives, methods and results of NASA programs.

OUTPUTS:

1. Broadcast media coverage of NASA science discoveries and results improve through the increased use of electronic means.
2. NASA communicates science news to the media that has historically covered NASA.
3. NASA's public speaker and exhibit programs convey NASA messages.

OUTCOME:

We work closely with the research community to provide ready access to data and analysis and we assist them in communicating these results and their significance to the broader public.

OUTPUTS:

1. Science communication has been incorporated into all appropriate scientific research announcements.
2. NASA provides access to data and information for the research community to communicate NASA's science results.

OUTCOME:

We cooperate with PUBLIC AND PRIVATE ORGANIZATIONS to leverage their unique skills, expertise and resources to significantly assist in the interpretation, APPLICATION and dissemination of information.

OUTPUTS:

1. NASA forms partnerships which communicate science.
2. NASA forms partnerships to develop innovative communications technologies, tools and products.

Appendix C

Science Communications Working Group (SCWG) IMPLEMENTATION PLAN

<u>Subject:</u>	<u>Action:</u>	<u>Actionee:</u>
Administrator's message on Science Communications	Develop and submit script	Chief Scientist/ Y lead, Codes S/U/F/P support
Incorporate Science Communications into NASA Mission Statement.	Chief Scientist propose changes to current Mission Statement in Strategic Planning process	Chief Scientist with support from Codes F, P, S, U, Y
Define proper government role for Science Communications	Establish NSTC Subcommittees	Subcm established. Will be supported by appropriate NASA offices
Incorporate science communications strategy/plan into Program Commitment Agreements and New Start requirements	Develop strategy for major science themes as they relate to missions and programs; revise existing NMT's	Science Codes, with Codes F, P support and concurrence
Incorporate science communications strategy/plan into program and project plans and provide for regular review of such plans	Develop as part of normal program planning activities, beginning immediately	Science Codes with Code F, P support and concurrence
Establish Integrated Communications Teams (ICT) for major science themes as they relate to major missions and programs	Immediately establish ICT's	Science Codes
Increase science community involvement in science communications	Develop and utilize selected "tools" in NASA research solicitations	Science Codes
Recognize excellence in public communication of science	Continue to encourage NASA employees to nominate external individuals for appropriate awards	Code F lead, Codes P/Y/U/S/ support
Establish Communications Roundtable and conduct quarterly meetings	Dailey memo to Officials in Charge establishing Roundtable and designating Code P as chair	Code P

Subject:	Action:	Actionee:
NASA Exhibits:	Review by Codes P, & Centers. Review inventory; develop and implement exhibits strategy; increase coordination; initiate study of creating on-line exhibits	Code P lead, Codes F/Y/U/S support
Customer Request Mechanism	Create a mechanism/process for responding to public inquiries	Codes P, F, lead, Codes Y/U/S support
	Prepare draft responses to frequently asked questions	Code P lead, Code F/Y/U/S support
	Explore greater reliance on automated information systems	Science Codes Codes P, F
	Science Codes to build electronic distribution into publication development	Science Codes
	Conduct feasibility study on "Post-Haste"-style 1-800 interactive information system	*Recommend Code J with support from Code P
	Explore increasing 1-800 access to Spacelink/Quest	Codes F and R
	Expand use of automated list servers	Science Codes Codes F, P
	Develop 1-page, NASA information request guide	Codes F, P
Increase use of leveraging in science communications	Seek new partnerships and undertake pilot leveraging efforts	Codes F, P, S, U, Y
Science Communications Training for Scientists	Develop training plan	Code F lead Science Codes, Code P support

*Code P recommends postponing study until after streamlining is implemented

Subject:	Action:	Actionee:
Computer Communications Technology		
-Establish coordination policy	Establish policy and format for electronic dissemination	Recommend CIO lead, Codes F, P, S, U, Y support
-Location of relevant NASA information and tools	Develop customer friendly paths and automated systems (feasibility study)	Code R lead, Other offices as appropriate
-Equitable and Universal Access	Conduct pilot program providing toll-free access to NASA info	Code O lead; other Codes as approp. (funding to be determined, may be an issue)
-Electronic Publishing	Conduct cost/benefit analysis of providing NASA publications electronically	Code J lead, Codes F, P, support
Minimize impact of loss of NASA Support Contractors	Explore use of IPA's, cooperative agreements, other SCWG options	Science Codes
Speaker's Bureau	Draft memo from Administrator to officials in charge encouraging support for NASA employee participation in the Speaker's Bureau	Code P
	Provide training on speaking and presentation	Codes P, F
Astronaut Appearances	Coordinate astronaut appearance priorities across NASA	Code P, with support from Code M, JSC

Appendix D

NASA Administrator's Letter to Participants of Chantilly, Virginia "Public Communication of NASA's Science" Meeting

Dear (Meeting Participant):

NASA is committed to communicating our science to the public more effectively. We have stepped up to the challenges you posed last year and recommitted ourselves to sharing the excitement and inspiration of our programs with all people.

I would like to highlight the progress NASA has made since our January 1994 meeting on the Public Communication of NASA's Science. Your participation in that meeting helped to spark an Agency wide reevaluation of our science communications activities. As a result, we have taken a number of steps (summarized in the enclosure) to improve our performance as science communicators.

Following the Chantilly meeting, Dr. France Cordova, NASA's Chief Scientist, led an Agency wide review to identify ways in which NASA could better communicate its science. We identified eight goals for the Agency which encompassed the themes discussed at the meeting. NASA also took a comprehensive look at the way the agency communicates science to ensure that any changes the agency made were long-term improvements. We developed a Science Communications Strategy to guide these efforts with over two dozen recommendations to implement the strategy, which are described in the first goal of the enclosure.

NASA recognizes that science communications is one of the most important activities the Agency can and should perform. One step we took was to include science communications as one of the Agency's goals in the 1995 update to NASA's Strategic Plan.

In 1994, the Administration issued a report, *Science in the National Interest*, identifying new national science goals. Two of the five goals are related to science communications: Produce the finest scientists and engineers for the 21st century and raise the scientific and technological literacy of all Americans. The goals and strategies outlined in the enclosure underscore NASA's commitment to communicate our science results effectively. However, we cannot do this alone. To achieve fully the goals in *Science in the National Interest*, I strongly urge you to challenge your colleagues to communicate, at every opportunity, the results and relevance of their science. Only in this way can the public reap the full benefit of its investment.

Sincerely,

[original signed by]

Daniel S. Goldin
Administrator

Enclosure

STATUS OF GOALS AND PLANS
RESULTING FROM
JANUARY 1994 NASA PUBLIC COMMUNICATIONS MEETING

INTRODUCTION

Since the January 1994 public communications meeting, NASA recognized that the goals and plans identified in this meeting were representative of broader science communications processes. Therefore, while NASA addressed these specific goals and plans, it also reviewed the broader science communications processes underlying the goals and plans to ensure that the resulting changes were long-term improvements in the manner in which NASA communicates science to the public.

Goal: Form a NASA Public Communications Steering Group.

A Science Communications Steering Committee was established in April 1994 to establish policies for and coordinate NASA's Science Communications activities. The Steering Committee is chaired by the NASA Chief Scientist and is composed of the Associate Administrators from the NASA Science, Public Affairs, and Education offices. The Steering Committee established a Science Communications Working Group (SCWG) to coordinate the goals and plans derived from the January meeting and to review and make more comprehensive recommendations on NASA's science communications processes and activities. The Working Group identified six principles that must guide NASA's science communications processes:

Leadership: NASA must provide interagency leadership to help define the appropriate Government role in communicating science.

Coordination: NASA efforts must be fully coordinated to focus a broad range of views and capabilities to most effectively communicate science to the public and to extend limited resources.

Integration: Science communications must be embedded in everything that NASA does, as an essential component of the Agency's mission.

Participation: Broader participation by key groups in communicating science -- most notably the scientific community -- is essential.

Leveraging: Whether through funding or partnership, NASA must work more extensively with external organizations and groups to effectively convey science results.

Evaluation: Metrics for performance and continual assessment of effectiveness should be a fundamental element of all efforts, followed by any necessary adjustments.

Complementing the work of the Steering Committee, NASA has established a NASA Information Center to coordinate NASA communications to ensure that they are timely and accurate.

Finally, as evidence of NASA's leadership initiative in communicating science, NASA's Chief Scientist was recently appointed as Chair of the National Science and Technology Council's Subcommittee on Communicating Science to the Public. This Subcommittee has been tasked with defining the appropriate role of the Government and in determining action to achieve the goal of communicating science to the public.

Goal: Develop education/outreach for NASA research missions.

To strengthen the translation of scientific research into science communications, NASA has developed the following flexible set of tools to use in its research solicitations:

- a. Requiring that science communications plans in appropriate NASA science activities be submitted and evaluated as an evaluation criteria in the awarding process.
- b. Issuing supplemental or separate educational grants.
- c. Encouraging research proposers to become more active in science communications.

Specific samples of these tools are enclosed as

Attachment A. Note in particular the recent Announcement of Opportunity for the planetary science missions named "Discovery." The announcement calls for a science communications plan as part of the proposal requirements.

In addition, each NASA science office is developing science education strategies in collaboration with the Office of Human Resources and Education to be consistent with the Agencywide education strategy. These strategies incorporate the unique educational aspects of each of NASA's science offices to support the national education agenda.

Further, the SCWG has developed plans for the use of integrated communications teams for the development of science communications products and activities for all major missions or program disciplines/themes. Such teams have successfully been used in the past to develop effective communications strategies; NASA's Hubble servicing mission is just one example.

Goal: Leverage the impact of NASA's mission products through proactive distribution of video, graphic and CD ROM materials to educators, science service organizations, museums, planetariums and the commercial sector.

NASA has tasked the Imaging Node of NASA's Planetary Data System (PDS), located at the U.S. Geological Survey (USGS) in Flagstaff, Arizona, to provide planetary images to educational product developers. NASA has identified \$100,000 in fiscal year 1995 to support USGS's enhanced role in this area. Further, a Management Operation Working Group (MOWG), composed of user representatives, the Imaging Node Director, a JPL public information representative, and scientists at large from the planetary science community, was established. The MOWG will advise the PDS Imaging Node on developmental and operations issues regarding public outreach. The members of the MOWG have exchanged written evaluations of current practices and ideas on the future direction of this activity in advance of their first formal meeting, scheduled for late April. In the interim, USGS is assisting individual educational product developers upon request; a more proactive approach is envisioned once the MOWG meets to discuss future direction.

Proactive electronic distribution of NASA mission products, research data, and other information has increased dramatically in the last year, as exemplified in the following:

- a. NASA Spacelink, our primary electronic information network for educators, has been upgraded to allow full internet connectivity as well as enhanced dial-in capacity and limited toll-free access.

b. Internet servers have been established at 10 NASA Centers, NASA Headquarters, the Goddard Institute for Space Studies, and for many NASA programs and services.

c. The Office of Public Affairs has created its Homepage; news and information is now available via Internet and Compuserve.

d. Three Internet sites were established for Shoemaker-Levy 9 data, resulting in 2.5 million public inquiries in just 1 week.

To help disseminate "hardcopy" materials to elementary and secondary educators, NASA Program Offices have increased their utilization of the Teacher Resource Center Network (TRCN). The Network comprises Teacher Resource Centers (TRC), located at NASA Centers, Regional Teacher Resource Centers (RTRC) at colleges and museums, and the Central Operation of Resources for Educators (CORE). Educators may copy NASA text, audio, visual, and computer materials at TRC's and RTRC's, while CORE processes U.S. and international educator requests by mail.

The SCWG has recommended that NASA develop "customer- friendly" paths through its online systems that allow customers to easily locate relevant NASA information and tools.

Further, the SCWG recommended that a cost/benefit analysis be conducted of transitioning NASA's publications facility into a "virtual warehouse" in which electronic access and print on demand of NASA publications would be possible.

Goal: Increase coverage of NASA activities and missions by the television medium.

A media outreach plan was developed to seek new opportunities to collaborate with producers of television, broadcast, feature film, and documentary productions to best communicate the Agency's missions and discoveries to the public. NASA recognizes the value of leveraging its resources by collaborating with the entertainment and broadcast media. A variety of projects are in progress involving the Discovery Channel, NBC, CNN, and PBS, to name a few. This initiative strengthens and expands efforts to better leverage NASA resources.

In January, NASA implemented a refocused NASA TV system to make the Agency's information more usable by the broadcast news medium. The new approach shifts from scheduled "programming," which benefits limited audiences, to real-time mission coverage and daily news feeds of material, such as live interviews with senior officials, scientists and engineers, as well as educational and historical materials. This approach has already enabled wider dissemination to the general public and allows NASA to directly reach important local, regional, and specialized markets with its story.

Our new approach to television is off to an excellent start. All networks picked up the El Nino story and transmitted it to affiliates. One-on-one interviews were conducted with 13 news networks and individual stations that reached an estimated two million households. El Nino also claimed substantial press coverage.

Goal: Expand use of new communication technologies as part of NASA's education technology plan.

NASA has concluded an agreement with the Wheeling Jesuit College in West Virginia to establish a Classroom of the Future (COTF) program. This cooperative arrangement will allow NASA's research data bases, technology tools, and technical expertise to be adapted to the needs of the educational community. This state-of-the-art facility was dedicated October 25, 1994, and staff was in place by December 1994. Teacher workshops will begin in 1995.

NASA has issued awards and grants for the development and application of technologies to help provide NASA science data to various user communities via the Internet. These awards and grants were issued by means of innovative solicitation approaches, involving commitment of resources of both NASA and the awardee. A list of the awards issued to date are enclosed as Attachment B.

Goal: Develop a NASA's Speaker's Bureau

NASA established a unified, Agencywide Speaker's Bureau. Officials-in-Charge across the Agency have identified skilled employees who can serve as speakers to a variety of audiences. A data base is being developed that characterizes the designated NASA speakers by geographical location, area of expertise, and speaking experience so that speakers can be better matched to the speaking engagement. NASA Centers expand the Agency's presence in communities within their region. Speakers can be scheduled by contacting either the NASA Headquarters Public Affairs office or the nearest NASA Center.

The following tools are being developed to enhance the speakers' ability to communicate:

- a. NASA themes, messages, and talking points
- b. "This is NASA" slide presentation
- c. Answers to 20 questions most commonly asked
- d. NASA Strategic Plan
- e. Up-to-date budget information
- f. Other support materials

Development of these products is already under way.

Goal: Establish award to recognize excellence in public education.

NASA has recently revised the language used in its annual call for awards to emphasize that non-NASA individuals should be considered for NASA awards for recognition of achievements in communication of science to the public and has encouraged NASA employees to consider the nomination of such non-NASA individuals. Specific awards that apply are the Distinguished Public Service Medal, Public Service Medal, Public Service Group Achievement Award, and Group Achievement Award.

Goal: Facilitate and enhance the Space Telescope Institute's education and outreach program.

NASA identified \$1 million this year to augment the highly successful education and public outreach program being run by the Space Telescope Science Institute (STScI) under contract to NASA's Goddard Space Flight Center (GSFC). These additional funds are being used to enhance existing activities to increase the numbers and types of materials being produced for communicating science to the public. In August 1994, STScI submitted a proposal to further enhance its science communications activities. As a result, NASA and STScI have agreed in principle to augment the existing contract between GSFC and STScI by \$3 million per year to expand STScI education and public outreach activities. In addition, STScI has agreed to assist in the administration of the Astrophysics Division's Initiative to Develop Education through Astronomy (IDEA) program; the IDEA program is described in detail on the following page. The total value added to the STScI contract should be in excess of \$3.4 million per year. It is expected that all final paperwork in support of this activity will be in place by the end of March 1995.

EXAMPLES OF SCIENCE COMMUNICATIONS RESEARCH SOLICITATION "TOOLS"

Direct Quotations from Existing Research Solicitations

Discovery Program – "The Discovery Program ... will also provide an opportunity for educational program activities that support the Nation's educational initiatives. Finally, the Discovery Program also represents an opportunity for NASA to enhance and broaden public awareness of, appreciation for, access to, and participation in, solar system exploration."

"Discovery investigations should include activities which will enhance the level of understanding and awareness of solar system exploration by the public. Public information programs that will inform the public by mass media or other means or other innovative ideas for bringing planetary science to the public are encouraged. Educational activities coordinated with educational institutions are also encouraged. Such activities might include substantial participation by teachers and students in the investigation and the development and utilization of programs that will involve educational institutions at any level in the investigation."

Initiative to Develop Education through Astronomy (IDEA) –

"The purpose of the IDEA program is to encourage the participation of research astronomers, particularly those funded by NASA, in experimenting with projects that take advantage of their special talents and the excitement of astronomy to promote greater mathematical, technological, and scientific literacy."

"IDEA grants are intended to promote math, science, and astronomy education among nonspecialists. It is, therefore, expected that most grants will target K-12 teachers and students or public audiences. However, some consideration will be given to innovative proposals to enhance or improve introductory college courses in astronomy or math/science literacy. In particular, proposals targeting undergraduate or graduate students training for careers in K-12 education are permitted and encouraged."

Space Physics Education Outreach (SPEO) Program --

"The intent of the SPEO program is to encourage the space physics research Principle Investigators and Co-Investigators to become actively involved with local schools and/or undergraduate colleges, as well as with appropriate public educational institutions such as science museums or planetariums. In doing so, it is emphasized that the purpose of this SPEO program is to provide educational opportunities and/or materials that promote general scientific literacy, especially with respect to the understanding of space sciences."

NASA Research Announcement on NASA Specialized Centers of Research and Training (NSCORT) --
The NSCORT program provides funding for institutions to advance basic knowledge and generate effective strategies for coping with specific problems in the life sciences area.

One of the goals of the NSCORT program is "to involve students, research scientists, and engineers from academia and the public and private sectors, so that the training of professionals is enhanced and that knowledge is transferred expeditiously among these sectors."

One of the evaluation criteria for awarding grants to become an NSCORT is "strength of proposed education and training plan and prior experience of the proposing institution in education and training."

REMOTE SENSING DATABASE (RSDB) AND DIGITAL LIBRARY TECHNOLOGY (DLT) GRANTS AND AGREEMENTS

A total of nine projects to develop RSDB applications are receiving funding through cooperative agreements or grants. They are:

Athena: Curriculum Development, Implementation and Support on the Internet -- a \$900,000 cooperative agreement between NASA and Science Applications International Corporation, Seattle, Washington. Associates include Northshore School District, Bothell, Washington; Seattle Public Schools, Seattle, Washington; Lake Washington School District, Kirkland, Washington; Bellevue Public Schools, Washington; and the Office of the Superintendent of Public Instruction, Olympia, Washington. The project will develop curriculum materials integrating ocean, weather, land and space data for grades K-12.

Bay Area Digital GeoResource (BADGER): A Model for Public/Private Shared Access to Earth Science Data Over the Internet -- a \$3 million cooperative agreement between NASA and Lockheed Missiles and Space Company, Research and Development Division, Palo Alto, California. Associates include NASA Ames Research Center, Moffett Field, California; International Geomarketing Corporation, Redwood City, California; and the City of Mountain View, California. BADGER will enable local governments, utilities, businesses and the public to find, use and share data sets referenced by geological features that help them manage current responsibilities and improve the quality of their products and services.

Earth System Science Community Curriculum Testbed -- a \$1.1 million cooperative agreement between NASA and ECOlogic Corp., Washington, DC. Gonzaga High School, Washington, DC, is an associate in this project. The effort will develop Internet access and curriculum materials for investigation-based science instruction by high school and college students.

Enhanced Access for Forest Management Planning -- a \$600,000 grant to the University of Minnesota. The Minnesota Department of Natural Resources, Grand Rapids, will cooperate in this endeavor to use LANDSAT imagery, digitized aerial photography and ground-based forest databases aiding in the management of forest resources.

Enhancing the Teaching of Science in Elementary Education Through the Application of NASA Remote Sensing Data Bases and Internet Technology -- a \$200,000 cooperative agreement between NASA and The Analytic Sciences Corporation, Arlington, Virginia, with support from the Franconia, (VA), Elementary School and the Fairfax, (VA), County school district. This project will develop weather-based curriculum for grades K-6.

Exploring the Environment -- a \$1.8 million cooperative agreement with the NASA Classroom of the Future at Wheeling Jesuit College, Wheeling, West Virginia. The project will develop computer software modules for use by high school students and teachers investigating Earth science questions via extended inquiries over the Internet.

NASA Digital Image Data Distribution for Education, Public Access, and Tourism in Hawaii: A Model System -- a \$900,000 grant to the University of Hawaii, Honolulu. Associates are the NASA Jet Propulsion Laboratory, Pasadena, California; Maui Community College, Kahului, Hawaii; Leeward Community College, Pearl City, Hawaii; and Highlands Intermediate School, Pearl City. This effort will prepare and present current data and imagery of the Hawaiian Islands over the Internet for use by the tourism industry as well as that of education, television, and researchers.

VOLCANOWATCH: Bringing Volcano Remote-Sensing Data to Classrooms and National Parks and Monuments -- awarded a \$900,000 grant to the University of North Dakota, Grand Forks. Other participants include Lincoln Elementary School, Grand Forks; University of Hawaii, Honolulu; Educational Services District 112, Vancouver, Washington; Gifford Pinchot National Forest, USDA Forest Service, Vancouver, Washington; and Hawaii Volcanoes National Park. The project will present information over the Internet covering current and historical activity of terrestrial and planetary volcanoes. Targeted audiences include visitors to Mount Saint Helens National Volcanic Monument and Hawaii Volcanoes National Park as well as grade-school students.

Public Access to Earth and Space Science Data Via Television -- a \$2.2 million cooperative agreement between NASA and WRC-TV, Washington, DC. Partners in this endeavor include the Jet Propulsion Laboratory, Pasadena, California; NASA's Stennis Space Center, Mississippi.; and the National Oceanic and Atmospheric Administration's National Weather Service, Washington, DC. The project will develop visualizations of current Earth and space science data to be included as part of the daily weather and news reports for WRC-TV and other NBC affiliates. More importantly, the data will also be available over the Internet for use in science classes.

The following six DLT projects are receiving funding to help provide for the future technologies for our libraries and research information:

Compression and Progressive Transmission of Digital Images -- a \$500,000 grant to the University of Wisconsin, Madison, and the Space Telescope Science Institute, Baltimore, Maryland. This team will improve the rate at which large digital images can be transferred across the network.

Creating the Public Connection: Interactive Experiences with Real-Time Earth and Space Science Data -- an \$800,000 grant to Rice University, Houston, Texas, in collaboration with the Houston Museum of Natural Sciences. The work will advance kiosk technology, allowing touch navigation through multidisciplinary science data, as well as making NASA data available to all who visit the Houston Museum of Natural Sciences.

Retrieval of Digital Images by Means of Content Search -- a \$2 million cooperative agreement with IBM Corporation, Yorktown Heights, New York. The project focuses on content retrieval on compressed images.

Test Applications and Digital Library Technologies in Support of Public Access to Earth and Space Science Data -- a \$2.1 million cooperative agreement between NASA and the University of Illinois, National Center for Supercomputing Applications, Urbana-Champaign. The team will develop Mosaic file format enhancements and a space science and astronomy server. Mosaic is a popular software tool used to access information on the Internet.

Useability and Interoperability: A Dual Strategy for Enabling Broader Public Use of NASA's Remote-Sensing Data on Internet -- a \$2.3 million cooperative agreement between NASA and Bellcore, Morristown, New Jersey, in collaboration with Camber Corporation, Huntsville, Alabama; Open GIS Foundation, Cambridge, Massachusetts.; and the Goddard Space Flight Center, Greenbelt, Maryland. The team plans to develop a virtual geodata model to enable broader public use of remote-sensing data.

"Reaching NASA from Home -- Internet Access via Cable TV" -- a \$700,000 cooperative agreement with Computer Sciences Corporation, Calverton, Maryland, in collaboration with Jones Intercable, Gambrills, Maryland; Integral Systems, Lanham, Maryland; and the Goddard Space Flight Center. The team will develop a system to provide Internet access to the general public using channels on a local cable television connection.

NASA INFORMATION INFRASTRUCTURE TECHNOLOGY AND APPLICATIONS (IITA) INTERNET GRANTS AND COOPERATIVE AGREEMENTS

Passport to Knowledge: Electronic Field Trips to Scientific Frontiers via Interactive TV and the Internet -- a \$902,000 cooperative agreement between NASA and The Childhood Project, Incorporated, Summit, New Jersey. The NASA-funded portion of this project will use the Internet to provide online access to scientists' diaries and other curriculum materials in support of live, national, and interactive television field trips to the Antarctic, the Kuiper Observatory, and the Hubble Space Telescope.

Surfing the Net: Aquatic Applications of Archival Satellite Imagery -- a \$266,000 cooperative agreement between NASA and the Gulf of Maine Aquarium, Portland, Maine. This project will develop innovative K-12 learning activities using online data to investigate the land-sea interface, oceanographic applications, and studies of the effect of human activities on the environment. Early efforts will be tested by classes in the Yarmouth, Maine, school district.

Windows to the Universe - An Earth and Space Science Internet-Based Active Learning System for the General

Public -- a \$900,000 grant to the University of Michigan to create a learning system for Earth and simulation-guided animation and voice overlays to be implemented in museums and libraries nationwide. Collaborators in this project include the Hands On Museum, Ann Arbor, Michigan; Cranbrook Institute of Science, Bloomfield Hills, Michigan; and Pioneer High School, Ann Arbor.

A Science Infrastructure for Access to Earth and Space Science Data Through the Nation's Science Museums -- a \$900,000 grant to the University of California, Berkeley, to create a national Science Information Infrastructure, a natural partnering of science museums, teachers, and research institutions to stimulate public awareness and use of remote-sensing data and to deliver this information to the general community. This project presents a consortium of museums which include the Smithsonian Astrophysical Observatory, Cambridge, Massachusetts; Lawrence Hall of Science, Berkeley, California; Boston Museum of Science, Boston, Massachusetts; The Exploratorium, San Francisco, California; National Air and Space Museum, Washington, DC; New York Hall of Science, Flushing Meadows Corona Park; and Science Museum of Virginia, Richmond, Virginia.

Dissemination of Atmospheric Sciences and Space Sciences Data and Information for K-12 and the Public: A Pacific Northwest Approach -- an \$880,000 grant to the University of Washington, Seattle, to make real-time and retrospective, atmospheric, and space science data available to the general public with special emphasis on products for use in science and mathematics instruction. Products will be tailored to display and explore the unique meteorology of the Pacific Northwest and the Puget Sound area.

Using Science and the Internet as Everyday Classroom Tools -- a \$667,000 cooperative agreement between NASA and the Smithsonian Institution Astrophysical Observatory, Cambridge, Massachusetts. Associates include Tenon Intersystems and AT&T. This project will develop a K-6 "hands-on" astronomy curricular theme that integrates science and Internet/computer activities into the daily life of the classroom.

Flood Management Enhancement Using Remotely Sensed

Data -- a \$609,000 cooperative agreement between NASA and SENTAR, Incorporated, Huntsville, Alabama, to provide enhancements to existing flood-management capabilities by using remotely sensed Earth data and the extension of Internet for the communication of data to the field.

Satellite Data-Driven, Real-Time Agricultural Management

Decision Aids – an \$842,000 grant to the University of Wisconsin, Madison, to develop four end-user applications of satellite data in the agricultural and environmental management arena: (1) irrigation scheduling for on-farm use, (2) irrigation electrical demand prediction system for power generation decisions by utility companies, (3) estimation of the duration of leaf wetness leading to foliar disease prediction in potatoes, and (4) prediction of frost damage for protection of cranberry crops.

Emergency and Crisis Management: A Remote-Sensing Application – a \$263,000 grant to the University of North Texas, Denton, to build an application on the Internet to demonstrate the usefulness of NASA's remote-sensing data for use in mitigation, preparation, response, and recovery from natural and technological disasters.

SAIRE - A Scalable Agent-Based Information Retrieval Engine – a \$600,000 cooperative agreement between NASA and Loral AeroSys, Seabrook, Maryland, with support from Bowie State University in Maryland. This project will develop an intelligent software program that will accept simple descriptions of a request, then correct errors or add missing information, learn the user's preferences, and shield the user from complex querying mechanisms in order to access and present Earth and space science data available over the Internet.

Appendix VII

- Copy of Unreimbursed Space Act Agreement Between NASA and Navajo Community College
- Letter of Appreciation from Albert Hale, President of the Navajo Nation
- News Article from Gallup (NM) *Independent*

COPY

UNREIMBURSED SPACE ACT AGREEMENT BETWEEN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND NAVAJO COMMUNITY COLLEGE

The National Aeronautics and Space Administration (NASA) and the Navajo Community College (NCC) enter into this Unreimbursed Space Act Agreement ("SAA" or "Agreement"), pursuant to the National Aeronautics and Space Act of 1958, as amended, 42 USC 2473 (c) (5) and 2473 (c) (6), as implemented by NASA Management Instruction (NMI) 1050.9A.

I. PURPOSE

This agreement shall be for the purpose of establishing a program and model by which NASA can provide assistance and guidance in developing modern communications technology and information to the Navajo Community College, to address their most important needs involving the development and implementation of quality educational programs.

Information gained from these efforts will benefit NASA by helping to develop a model for technology transfer, education and innovative research that can be deployed into targeted communities. This particular program will also provide NASA with a opportunity to inspire young Native Americans so that they may contribute to NASA's goals and to our Nation's society and economy. These programs are related to NASA's programs and projects via new network applications and the new uses of future telecommunications infrastructures.

II. RESPONSIBILITIES

2.1 NASA will contribute training in wide area networking and associated capabilities and provide assistance in establishing Internet connections, hardware, and cost of monthly line fees. The cost of the line will be reevaluated every year to determine continued support.

2.2 NASA will leverage different group's expertise to assist the sites in utilizing the information resources and distance education opportunities available utilizing the Internet to their fullest potential.

2.3 The Navajo Community College, will be responsible for establishing and supporting a local area network that will be compatible with the wide area connection. The Navajo Community College will both be responsible for complying to NASA Science Internet's acceptable use policy.

III. FINANCIAL OBLIGATIONS

3.1 The parties will not exchange funds or other financial obligations under this agreement. Each party will bear the cost of its own participation in the research effort.

3.2 All activities under or pursuant to this agreement are subject to the availability of appropriated funds. Nothing in this agreement commits the United States Congress to appropriate funds for this research effort, and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 USC §1341.

IV. PRIORITY OF USE

The parties' participation and contribution of their resources to this effort are based upon their projected use of and internal need for these resources, made at the time of entering the SAA. If either party's projected use or internal need changes during the term of this agreement, that party shall notify the other party within a reasonable time so that the parties may mutually agree to modify the research efforts accordingly. The parties agree that their internal use of their resources has priority over the efforts stated herein, and each party has sole discretion whether and when to exercise that priority.

V. LIABILITY AND RISK OF LOSS

5.1 Both parties agree to waive any and all claims or other legal actions for loss, damage, personal injury, or death, against the other party arising out of or pursuant to this Agreement, regardless of the legal grounds of the claim or action.

5.2. General Limitation of Liability to Direct Damages: To the extent that a risk of damage or loss is not dealt with expressly in this Agreement such party's liability to the other party, whether or not arising as the result of alleged breach of this Agreement, shall be limited to direct damages only, and shall not include any loss of revenue or profits or other indirect or consequential damages.

VI. SCHEDULE AND MILESTONES

The schedule and milestones for performance of this Agreement will be subsequently determined by the parties.

VII. DATA RIGHTS

N/A

VIII. PATENT AND INVENTION RIGHTS

N/A

IX. INDEPENDENCE OF CONTRACTS

The parties agree that this SAA is independent of any other contract between the United States Government and the Navajo Community College. By participating in this Agreement, NASA makes no assurances to the Navajo Community College or others as to the performance of the objects tested in NASA facilities or other test objects, and relieves the Navajo Community College of none of their obligations under any other contract with the Government. This agreement does not constitute NASA's endorsement of any test results, resulting designs, hardware, or other matters.

X. KEY PERSONNEL

The personnel listed under this section are designated as the key officials for their respective party. These key officials are the principal point of contact between the parties in the performance of this Agreement.

Navajo Community College	NASA Ames - NASA Science Internet
Name: Dr. Tommy Lewis, Jr.	Name: Milo Medin
Title: President	Title: Project Manager
Tel. no. 602-724-3311	Tel. no. 415-604-6440
Address: P.O. 67	Address: M/S 233-8,
Tsaile, AZ 87420	Moffett Field, CA 94035

NASA Headquarters - Life and Biomedical Sciences & Applications

Name: Dr. Joan Vernikos and Dr. Gary Coulter

Title: Division Director (Vernikos); Special Assistant for Education and Outreach (Coulter)

Tel. no. 202- 352530 (Vernikos)

202-479-2609 (Coulter)

Address: Code UL

NASA Headquarters

Washington, D.C., 20546

XI. ADDITIONAL PROVISIONS

11.1 (a) All parties will use reasonable efforts to participate in the research efforts stated in this SAA. NASA's ability to participate in this SAA is subject to the availability of appropriated funds. If appropriated funds are not available, NASA may terminate this SAA as provided in paragraph 11.7(b), below.

11.2 This SAA is not intended to constitute, create, give effect, or otherwise recognize a joint venture, partnership, formal business organization, or agency agreement of any kind, and the rights and obligations of the parties shall be only those expressly set forth herein. All parties will remain independent contractors; each responsible for its own employees, costs, risks, liabilities, and expenses incurred by its participation in this effort.

11.3 NASA will participate in this research effort consistently with its obligations under the treaties, laws, published policy, and regulations of the United States of America. Federal laws shall govern this agreement.

11.4 Neither party shall make any claim, lawsuit, or take any other legal action against the other party with respect to injury or death of its own or its contractors' or its subcontractors' employees, or damage to or loss of its own or its contractors' or its subcontractors' property, arising out of or connected with this agreement or the parties' participation in this agreement, whether such injury, death, damage, or loss arises through negligence or otherwise. If any liability is otherwise imposed on either party to the other, that liability, whether or not arising as a result of an alleged breach of this agreement, shall be limited to direct damages only, and shall not include any loss of revenue or profits or other indirect or consequential damages.

11.5 No member or delegate to the United States Congress, or resident commissioner will be admitted to any share or part of this SAA, or to any benefit that may arise therefrom, but this provision will not be construed to extend to this SAA if made with a corporation for its general benefit.

11.6 (a) This SAA may be modified at any time by a written document signed by officials authorized to bind the parties.

(b) Neither this SAA nor any interest arising under it shall be assigned by either party without the consent of the official authorized to bind the parties.

11.7 (a) The term of this SAA will be one year beginning on the date of the last signature appearing below, or as provided for in paragraph 11.7(b), below. This SAA may be extended for additional one year periods by modification, as provided for in paragraph 11.6(a) above.

(b) Either party may terminate this SAA, at any time before the date provided in paragraph 11.7(a), by written notice to the other party thirty (30) days before the desired date of termination. The terminating party will not incur any liability to the other party for terminating this SAA under any provision of paragraph 11.7.

Joan Vernikos

Date: 2/9/95

DR. JOAN VERNIKOS
DIRECTOR, LIFE & BIOMEDICAL SCIENCES &
APPLICATIONS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HEADQUARTERS

Tony Villaseñor

Date: 2-1-95

TONY VILLASEÑOR
PROGRAM MANAGER, NASA SCIENCE INTERNET
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HEADQUARTERS

Tommy Lewis, Jr.

Date: 2-24-95

DR. TOMMY LEWIS, JR.
PRESIDENT
NAVAJO COMMUNITY COLLEGE



THE NAVAJO NATION

P. O. BOX 9000 • WINDOW ROCK, ARIZONA 86515 • (602) 871-6000

ALBERT A. HALE
PRESIDENT

May 3, 1995

THOMAS E. ATCITTY
VICE PRESIDENT

Dr. Joan Vernikos
Director, Division of Life and Biomedical
Sciences and Applications (Code UL)
NASA Headquarters
Washington, D.C. 20546

Dear Dr. Vernikos:

On behalf of the entire Navajo Nation, thank you for your commitment and efforts to provide Internet connectivity, training and necessary equipment to assist the development of a telecommunications infrastructure within Navajo Community College (NCC) and the surrounding community. combined with the activities of the recently initiated Navajo Nation Telecommunications Infrastructure Program, NASA's efforts will contribute significantly to providing quality education, health, and public service programs to the Navajo people.

As you know, part of NASA's commitment to NCC, which is called out in the recently signed unreimbursed Space Act Agreement, is to provide Internet connectivity to the college. Recently, there have been discussions concerning whether the connectivity should be established at Window Rock, AZ or at Shiprock, NM. Window Rock is the capital city of the Navajo Nation and Shiprock is the location of the NCC's science and technology campus.

After careful consideration of the relative benefits of each of these options, I have decided that installation of at least a 56Kbps line into the NCC campus at Shiprock, NM is in the overall best interest of NCC and the Navajo government. Please take whatever steps are necessary to communicate this decision to the NASA Science Internet organization so that work can proceed.

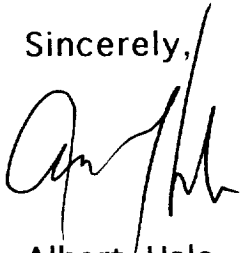
As you know, connectivity must be established prior to August 4, 1995 in order to support the teachers returning from the Summer Teacher Enhancement Program offered this summer at the Johnson Space Center. The teachers and administrators of Central Consolidated School District #22 at Shiprock are very excited about the opportunities that the STEP program and Internet connectivity will provide them as

they continue their efforts to provide quality educational programs to our children.

The NCC contact for telecommunications technology is Dr. Mark Bauer at (505) 368-5164 and the point of contact within the Navajo Nation is Mr. John Billison at (520)871-7058 or 7840.

Again, thank you for your continuing support of Navajo Community College and the Navajo Nation. I look forward to working with you on this most important and exciting endeavor.

Sincerely,



Albert Hale
President

xc:

NAVAJO

NATION/

Thomas Atcitty, Vice-President
Office of the President/ Vice-President
John Billison, Information Technology Team Leader
Office of the President/ Vice-President
M. Teresa Hopkins, Agency Network Project
Office of the Speaker

NCC/

Dr. Tommy Lewis, President
Dr. Mark Bauer

NASA HQ/

E/

Dr. Freeman

ST/

Dr. Villasenor

UL/

Dr. Coulter

JPL/

Dr. Shair
Mr. Jacobson

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Zah reflects on his presidency

By Mark Engler
Dine Bureau

WINDOW ROCK, Ariz. — Inside the Navajo Executive Branch headquarters on Inauguration eve, as staffers emptied the contents of

drawers, removed family portraits from desktops and took down commemorative photographs from the office walls that have surrounded Zah Administration officials for the past four years, Peterson Zah him-

self sat at his desk one last time and took a few moments to reflect.

The clock winding down on his second term as president of the largest Indian Nation in the United States, Zah said that if he had the

opportunity to relive his latest presidency he would change little.

He may have lost the November election to Albert Hale and his promises of change, but Zah says he

See Zah, Page 2

Experts pursue getting Navajos on Information Superhighway

By Malcolm Brenner
Staff writer

SHIPROCK — It was a meeting at the crossroads of the Corn Pollen Path and the Information Superhighway.

A forum Monday at Navajo Community College's Shiprock campus brought together NASA

scientists, politicians, educators and tribal employees to bit-map plans for bringing 21st-Century telecommunications to the remotest regions of the Navajo Nation.

At the end of the 20th Century, many parts of the 26,000-square-mile reservation still lack electricity, running water, and paved roads.

"It's a humongous task," said conference facilitator Steve Grey, director of Lawrence Livermore Laboratory's American Indian Program, headquartered at the NCC Shiprock campus. "I don't think anybody in this room can master it."

Grey estimated the cost of getting the Navajo Nation on-line in

the millions of dollars. While the project will be expensive, the rewards, said participants, will be great, for the Navajo Nation and the nation at large.

"We're trying to attract those minorities who were historically under-represented in the education

See Experts, Page 2



Despite recent winter storms, Navajo Nation President Albert Hale, due to the efforts of businesses which donated tin stage and seating for the ever

McKinley Board agrees to another hearing on s

Experts / Pursue getting Navajos on Information Superhighway

system," said Dr. Gary R. Coulter, a University of Colorado biologist, under contract to the National Aeronautics and Space Administration. "These are American resources."

The question, Coulter said, is how Navajos and other Native Americans can retain their cultural identities while gaining equal access to the information superhighway made possible by computers and advanced telecommunications.

In his opening remarks, Sen. Leonard Tsosie, D-Crownpoint, made a joke that captured the essence of the situation.

"I told my cattle this morning I couldn't break the ice on their water trough today because I had to attend a telecommunications conference. My cattle said, 'What if we die of thirst?'"

"Our traditional concerns have been livestock, but the information superhighway is being developed," Tsosie said. "We have Navajo kids in Ojo Encino who want to see the comet impacts on Jupiter. Why shouldn't they? How can they?"

Monday's conference was the first follow-up to a survey on the Nation's information infrastructure which Coulter and Dr. Jake Jacobson, with the Jet Propulsion Laboratory, in Pasadena, conducted last spring. Each of the 31-some participants covered their own costs to attend.

During the day-long forum, the talk swung from highly technical discussions of band width and switching devices to cultural sensitivity to the uses the average Navajo might find for an advanced telecommunications system, capable of linking him with information from anywhere in the world -- even the Navajo capital, Window Rock, famous for its slow-moving bureaucracy.

The focus was on standardizing and linking telecommunications services now expanding piecemeal onto the reservation from different sources and suppliers such as Northern Arizona University and the University of New Mexico.

The proposed plan would link schools and chapter houses across the reservation with service providers such as the Bureau of Indian Affairs, law enforcement agencies, the Indian Health Service, Navajo Community College and the Navajo government.

Further links would reach out to the Internet and other on-line services across the country and around the world.

Participants hoped that a Navajo plan to implement a pilot fiber-optic telecommunication system at the vocational Crownpoint Institute of Technology might serve as a model for other Indian nations and underdeveloped parts of the U.S.

The current 50K technology planned for Crownpoint could transmit video, voice and data simultaneously, enabling the seven branches of Navajo Community College, located hundreds of miles apart, to share courses, said President Dr. Tommy Lewis.

But Teresa Hopkins, the Navajo Nation's information Technology

acquire right-of-way for the communication lines.

All land on the reservation is owned by the tribe, but the traditional holders of grazing rights must give their consent before such projects can be developed.

Getting approval from the various levels of Navajo government and the need for archaeological and environmental clearances further complicates the pilot project.

The Navajo land issues have been resolved, but Hopkins' office is awaiting BIA clearance to start laying cable.

"Unfortunately we can't cut through the bureaucracy, because the Navajo Nation still has to go through the Bureau of Indian Affairs and that's where all the budgets are still approved," Hopkins said.

Another obstacle is educating users of the system at each of the Nation's 110 chapters.

"Communities have individual needs. They ask, 'How does this apply to me?'" Hopkins said. "Our office had to visit each individual and user. You can bring them to a class and dazzle them, but once they get back to Black Rock they ask, 'So what?'"

A big incentive for users would be the ability to track home site and business leases through the complicated signature authorization process, which can take months or years.

Hopkins has modified the Navajo government's Macintoshes to make them more user friendly. Instead of beseeching for an error, the machine says the Navajo word for "Stupid!" A graphical interface features a robot that speaks Navajo.

While some participants favored waiting for the money to build a state-of-the-art system that could fill all foreseeable future needs, others advocated moving ahead with more accessible, less expensive current technology.

"Do it without delay," said Andy Andrews with Los Alamos National Laboratory. "We've got to get our act together and get people involved with the communications process. Especially young people -- they'll take that technology that's in place and leave us in the dust."

The end of the day saw committees formed to handle the technical questions, resources and applications, overseen by a steering committee chaired by Hopkins and Mark Bauer, the director of NCC science and math programs.

More meetings are planned, some by teleconferencing -- when and if it becomes available in Shibeau.

"For the first time, it was a real multi-disciplinary group coming together and finding out they've got a heck of a lot in common," Coulter said.

Grey was gratified by the work the forum had accomplished in one day.

"Federal agencies have to give back to the public. Indian nations request that, we've been left out for years and years," Grey said.

"The biggest thing from this is, we brought an awareness to the in-

but the brakes," said truck driver W. J. Burns of Dublin, Va. His truck stopped in the median.

"It was clear. The next thing you know -- pow! -- zero visibility," Kipson said.

The highway is a major cross-country route, running from Barstow, Calif., to Wilmington, N.C. A 13-mile stretch was closed most of Monday.

Feds seize \$26 million in fake bills

SAN FRANCISCO (AP) — Federal agents seized \$26 million in counterfeit bills from a printing company and arrested three employees.

The phony currency was in uncirculated sheets of \$100, \$50 and \$20 bills. It was the largest domestic counterfeit seizure in Secret Service history, the Justice Department said in a press release Monday.

The three men arrested Saturday used the press at Thomson Lithograph in Fremont, Calif., after business hours, authorities cooperated with the Secret Service during the monthlong investigation.

Detectives said the three employees planned to print \$30 million for distribution in San Francisco and Hawaii. They took up to 15 years in prison and \$250,000 in fines if convicted.



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Appendix VIII

Article in *Informations Systems* magazine highlighting the LBSAD's Native American Education and Outreach Activities with the Cherokee Nation of Oklahoma.

Cherokee Nation Establishes a Network Node

Sheli Meylor, NASA Science Internet, and Pat Kaspar, Contributing Editor, Ames Research Center

The Cherokee Nation is working to develop the self-reliance and independence of its people by enhancing their knowledge, skills, and self-responsibility.

The Cherokee Nation Tribal Complex in Tahlequah, Oklahoma, is now connected to the Internet. Due to the combined efforts of NASA Headquarter's Life & Biomedical Sciences & Applications Division and the NASA Science Internet (NSI) at Ames Research Center, they are an official node on the network—with a 56-Kb/s line to the Internet. Under the terms of the Space Act agreement signed in February 1995, NASA's Outreach and Education project, in conjunction with representatives from NSI, will provide telecommunications technologies to the Cherokee Nation's Tribal Complex. The Cherokee Nation will establish and support a local area network that will serve as a hub to extend the technology to nearby schools and communities. The Office of Life and Microgravity Sciences and Applications' Outreach and Education project is led by Rose Grymes, with the support of Colorado State University's Gary Coulter.

The Cherokee Nation is composed of geographically remote and widely separated communities. Access to modern telecommunications technologies will allow them to address their most important needs, including access to quality education, quality health care, and information that can help stimulate economic development and foster better government-to-government relations.

According to Sheli Meylor, technical lead for NSI on this project, "The partners in this venture have similar goals. The Cherokee Nation is working to develop the self-reliance and independence of its people by enhancing their knowledge, skills, and self-responsibility. NASA, through its partnership with the Cherokee Nation, is working to channel the excitement and uniqueness of NASA's missions to Native American students, and support the development of future space scientists and engineers."

The long-range goal of the program is to extend Internet connectivity over time into the Native American community at large through a program of education and community involvement. NASA will guide these communities through targeted outreach programs showing them how to obtain local support from businesses and industry, and how to maintain a program that will ensure broad and sustained access to the global information infrastructure. The ultimate goal is to make the Internet programs in these communities self-sustaining.

Over the summer, three educators from nearby Sequoyah High School participated in the Summer Teachers Enhancement Program (STEP) held at the Johnson Space Center (JSC). The STEP program, hosted by Gerry Taylor and Robert Fitzmaurice at JSC, presented training on NASA's missions and demonstrated using the Internet to access online educational resources and to keep abreast of NASA's activities. Through the Internet, these educators will be able to use NASA's teacher resources, communicate with the astronauts (via the online service, Spacelink), and share information with educators from other Native American tribes.

Signatories of the February 1995 Space Act Agreement included the Director of NASA's Life & Biomedical Sciences & Applications Division, Joan Vernikos, the NSI Program Manager, Tony Villasenor, and the Director of Education for the Cherokee Nation of Oklahoma, Jim Quetone.

For further information contact Sheli Meylor at:

sheli@nsipo.nasa.gov